

# LLOYDIA

*A Quarterly Journal of Biological Science*

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Vol. 5, Nos. 1-4, 1942

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Number 1, March.....	April 22
Number 2, June.....	June 29
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Number 4, December.....	December 30

# LLOYDIA

## *A Quarterly Journal of Biological Science*

Published by the Lloyd Library and Museum, Cincinnati, Ohio

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### Studies in North American Species of *Hygrophorus*-II\*

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Knoxville, Tenn.*)

In our (20) previous study we gave an account of the North American species of the subgenus *Limacium*. In it we stated that *Hygrophorus* in north temperate regions was readily divisible into three subgenera, *Limacium*, *Camarophyllus* and *Hygrocybe*. Since that time, because of additional information, we have had to add another subgenus, *Pseudo-Hygrophorus*. Because a number of species of *Limacium* have been added to the known flora of North America since our account was published, we have included here a revised key to that subgenus with descriptions of the additions so that these two papers represent a reasonably complete treatment of the North American species for the entire genus. We have not attempted to account for every name applied to American collections. Most publications include only a few of the common species. We have tried to bring together all American reports accompanied by complete descriptive text as well as accounts of all species described as new from North America. In addition to this, we have included the results of our own field work and Kauffman's records and unpublished notes.

Our field work has been continued as previously outlined. The senior author, with the aid of grants from the Horace H. Rackham School of Graduate Studies of the University of Michigan, spent the spring and early summer of 1939 collecting in the Olympic Mountains of Washington and the fall season of 1941 in the Olympics and northern Cascade Range. He has also continued his studies of the Michigan flora. The junior author has continued his collecting in eastern Tennessee and the apparently inexhaustible Great Smoky Mountains National Park.

In the following account we have recognized one species in *Pseudo-Hygrophorus*, twenty-one in *Camarophyllus* and sixty-two species and varieties in *Hygrocybe*. In *Limacium* nine additional species have been

\* Contributions from the University of Michigan Herbarium and the Botanical Laboratory, the University of Tennessee N. Ser. 48.



added to those included in our previous account. Specimens have been deposited in the herbaria of the University of Michigan and the University of Tennessee in so far as the collections allowed. All color names within quotation marks are taken from R. Ridgway, Color Standards and Color Nomenclature, Washington, D. C. All descriptions not in quotation marks or otherwise qualified have been drawn from fresh specimens. We have given the distribution of the various species by states, and, unless qualified to the contrary, we have examined specimens from the states listed. Individual collections are cited only for new species or for reports of those that are rare or poorly known.

#### COMMENTS ON THE LIMITATIONS OF THE SUBGENERA OF HYGROPHORUS

Our continued study of *Hygrophorus* has impressed us more and more with the duplication of stature and markings of the species in the various subgenera. Attempts, for instance, to establish the subgenus *Limacium* on any other character or combination of characters than divergent gill-trama have met with only partial success. Peck, as is evidenced by the results of our study, was unable to distinguish species of the section *Clitocyboides* of *Limacium* from the *Camarophylli* and species of *Hygrocybe*. Peck's difficulty was no doubt caused in part at least by the fact that Fries himself placed species which we now know belong in *Limacium*, in *Camarophyllus*, and thus misled other investigators. The difficulty of distinguishing between species of *Limacium* and *Camarophyllus* is well illustrated by the similarity between *H. albidus* and *H. niveus*. These two are often practically indistinguishable except for the arrangement of the gill-trama. In the present study additional instances of similarity have come to light.

*H. angelesianus* is almost indistinguishable from *H. subviolaceus* except for its amyloid spores and the reaction of its flesh and gill-trama to KOH. *H. sphaerosporus*, which has been found by us to belong to *Hygrocybe*, is practically indistinguishable in the dried condition from *H. albipes*, of *Camarophyllus*. *H. brevipes* very closely resembles pale forms of *H. pratensis*. The discovery of such cases of parallel appearance, in our estimation, forms a practical argument for classifying all the species in a single genus.

It is well known that many species of *Hygrocybe* have what is generally referred to as subparallel gill-trama. In such species the individual hyphal cells are very broad (7–20 $\mu$ ) and variable in length. They are somewhat tangled or interwoven. In distinguishing between the two subgenera, *Hygrocybe* and *Camarophyllus*, we have frequently found it difficult to decide how "interwoven" the trama can be and still be classed as "subparallel." Here one is faced with the difficulty that the width of the hyphae varies greatly and alone does not form a safe criterion for classifying the species even though generally speaking, those with hyphal cells consistently

over  $7\mu$  would go in *Hygrocybe* and those with cells under  $7\mu$  in *Camarophyllus*. In a typical specimen of *Camarophyllus* the hyphae will measure  $3-6\mu$  in dia. and be very intricately interwoven. Nearly all such species have decurrent gills. In *H. hymenocephalus*, however, the trama is truly interwoven and the cells measure  $5-17\mu$  in dia. Most members of *Hygrocybe* with decurrent lamellae are bright colored, and one is justified in saying that the true *Camarophylli* can usually be distinguished macroscopically by the combination of dull colors and decurrent gills. Here again, however, we have *H. deceptivus* in *Hygrocybe* with subparallel gill-trama, somewhat decurrent gills, very small spores and dull brown colors. If it were not for its gill-trama, this species would be placed in the section *Microspora* of *Camarophyllus*. Jossierand (4) has commented on the more or less interwoven condition of the gill-trama in *H. sciophanus*. We have found nearly all of the American species of the section *Viscidipedes* to have more or less interwoven trama, but distinguish them from *Camarophyllus* by their viscid stipes.

We have tried to express the intergrading condition of the gill-trama in the following outline of our classification. In *Hygrocybe* we have created the section *Pseudo-Camarophyllus* to care for the species which, in the character in question, do not clearly belong to one group or the other but which, because of their colors, have usually been classified in *Hygrocybe*. Because of the intergradation which we have found to exist between *Camarophyllus* and *Hygrocybe*, we are somewhat inclined to question whether the two groups can be maintained as subgenera.

#### OUTLINE OF PROPOSED CLASSIFICATION

I-Subgenus *Limacium*: Gill-trama of divergent hyphae.

II-Subgenus *Pseudo-Hygrophorus*: Gill-trama interwoven, spores amyloid.

III-Subgenus *Camarophyllus*: Gills decurrent, gill-trama intricately interwoven, colors usually dull.

Section 1: *Microspora*

- subsections: 1. *Impoliti*
- 2. *Odorati*
- 3. *Hymenocephal*i
- 4. *Pelliculosi*

Section 2: *Eu-Camarophyllus*

- subsections: 1. *Viscidi*
- 2. *Subaquosi*
- 3. *Impoliti*

IV-Subgenus *Hygrocybe*: Gill-trama usually more or less regular, the individual cells large ( $8-20\mu$  in dia.); colors often bright.

Section 1: *Pseudo-Camarophyllus*

- subsections: 1. *Squamulosi*
- 2. *Laevi*

Section 2: *Eu-Hygrocybe*

- subsections: 1. *Conici*
- 2. *Obtusi*

Section 3: *Viscidipedes*

- subsections: 1. *Laeti*
- 2. *Obscuri*



## COMMENTS ON SPECIFIC CHARACTERS

In general our (20) comments on *Limacium* also apply to the rest of the genus. The viscidility of the stipe in species of *Hygrocybe*, however, is not caused by a gelatinizing universal veil as in *Limacium*, but rather by the gelatinizing of the outer layer of hyphae forming the stipe, as in *Mycena*, or by the gelatinization of narrow innate hyphae which project out from the stipe. The viscidility of the stipe in *Hygrocybe* is a very important character, but one which is also easily misinterpreted. Usually, if the stipe is truly viscid, it will be so slimy that the collector will find it difficult to take hold of it. In a few species, however, this is not true. In others with a very soft consistency, the stipe has the slight tackiness one is likely to notice in touching a wet surface. This tackiness is often accentuated by the collector pressing so hard on the stipe that the surface becomes damaged slightly and is then more slippery than usual, but should not be classed as viscid. The best way to determine whether or not the stipe is viscid is to section carefully fresh uncrushed portions and examine the periphery for hyphae whose walls appear gelatinous. If such are found, the species should be sought for in the section *Viscidipedes*. The gelatinous hyphae can usually be demonstrated from herbarium specimens as well, but here negative results are not necessarily conclusive. The same technique should be used to determine whether or not the pileus is viscid if that character is doubtful. Generally speaking, the pellicle of the pileus is easier to demonstrate than the gelatinous hyphae of the stipe. This is particularly true of herbarium specimens.

Most species of *Hygrophorus* have unusually long flexuous basidia. However, in our study we have encountered a fairly large number of species in which the basidia do not appear to be different from those of other white spored agarics. In *H. microsporus* the basidia are very small ( $26-30 \times 3.5-5\mu$ ), but are typical in shape. In *H. obconicus* as we recognize the species, they are  $22-28 \times 5-6\mu$ , and are not different from those of other white spored agarics. In *H. huronensis* they measure  $28-34 \times 8-10\mu$  and are more like the basidia of a *Mycena*. In *H. flavescens* they measure  $30-35 \times 7-10\mu$ . The long flexuous basidia are apparently typical for *Limacium* and *Camarophyllus* whereas in *Hygrocybe* both types occur quite frequently.

Other characters such as color, odor, taste, gill attachment and spacing, and spore size are all important in delimiting species. We have not encountered any *Hygrophori* with rough or angular spores. *H. Graciae* Sumstine was described as having angular spores. We have examined a portion of the type and believe it is synonymous with *Entoloma cuspidatum*.

Although great emphasis is here placed on color, one must always determine not only the range of variation, but also the changes that take place from youth to age. In some species, such as *H. laetus*, variability of color is characteristic; there being many different pigments making up the

composite color of the fruiting body. In others the color is monochromatic or lacking (the white species). The color of the stipe is also important, but one should be cautious in using it. Among the species with dull colors, the stipe may be white or dark depending apparently on light conditions. Fruiting bodies growing in exposed places are likely to have dark colored stipes whereas the same species, fruiting in shady places, will produce fruiting bodies with white stipes. In a few *Hygrophori*, such as *H. marginatus*, *H. flavifolius* and *H. sciophanus*, the color of the gills is very persistent and aids materially in distinguishing the species.

## KEY TO THE NORTH AMERICAN SPECIES OF HYGROPHORUS

- I. Spores amyloid, gill-trama intricately interwoven (The only species is keyed out in the key to *Camarophyllus*)..... Subgenus *Pseudo-Hygrophorus*.
- I. Spores not amyloid..... II
- II. Gill-trama of divergent hyphae (See the appendix for a revised key and additional species)..... Subgenus *Limacium*.
- II. Gill-trama of interwoven or parallel hyphae..... III
- III. Gill-trama intricately interwoven, cells 3-7(10+)  $\mu$  wide, gills decurrent, colors usually dull or white (*H. hudsonianus* is yellow)..... Subgenus *Camarophyllus* p. 7
- III. Gill-trama more or less regular or somewhat interwoven, color of fruiting body usually bright..... Subgenus *Hygrocybe* p. 24

## KEY TO SPECIES OF PSEUDO-HYGROPHORUS AND CAMAROPHYLLUS

1. Odor distinctive..... 2
1. Odor not distinctive..... 4
2. Lamellae grayish violaceous or purplish..... *H. mephiticus* (No. 44)
2. Lamellae pallid or brownish..... 3
3. Lamellae almost fold-like or very narrow, pileus Isabella-color when young, darkening in age..... *H. paupertinus* (No. 9)
3. Lamellae moderately broad and whitish, pileus mouse gray when young and when dried..... *H. Peckianus* (No. 8)
4. Spores globose to subglobose, 4-6  $\mu$  dia..... 5
4. Spores ellipsoid (4  $\times$  2.5-3  $\mu$  in one species)..... 13
5. Pileus covered by a hymeniform palisade of clavate cells, stipe smooth..... *H. hymenocephalus* (No. 10)
5. Pileus with a gelatinous pellicle of narrow appressed hyphae or the pellicle scarcely differentiated..... 6
6. Gills tinged grayish violet or dark violaceous..... 7
6. Gills white or whitish or variously colored, but not as above..... 8
7. Pileus smoky lilac when moist, subviscid when young, stipe white to whitish..... *H. pallidus* (No. 11)
7. Pileus hoary when young, sometimes slightly moist but not subviscid, stipe pallid purplish..... *H. canescens* (No. 6)
7. Pileus grayish brown when moist, not viscid, stipe whitish or pallid..... *H. basidiosus* (No. 5)
8. Pileus moderately large (2-5 cm.), gills close to crowded, narrow..... *H. angustifolius* (No. 2)
8. Pileus (so far as known) smaller, 1-2.5 cm. broad, gills subdistant to distant..... 9
9. Spores sphaeroid, 5-7.5  $\mu$ ..... *H. sphaerosporus* (No. 45)
9. Spores subglobose, smaller..... 10
10. Pileus white to cream-color at first..... 11
10. Pileus grayish brown (pale avellaneous at first)..... 12
11. Lamellae pallid to gray, pileus slimy-viscid (See Smith and Hesler, 20)..... *H. subluridus*
11. Lamellae white..... *H. obconicus* (No. 4)
11. Lamellae bright yellowish white..... *H. cremicolor* (No. 18)
12. Lamellae subdistant to close, broad..... *H. obconicus* and related forms (No. 4)



12. Lamellae subdistant, narrow.....*H. albipes* (No. 3) 14
13. Lamellae tinged with lilac-gray or violaceous gray..... 15
13. Lamellae some other color..... 15
14. Taste of pellicle usually bitter, flesh not turning reddish in KOH... *H. subviolaceus* (No. 12) 15
14. Taste of pellicle mild, flesh turning haematite red when treated with weak KOH.....  
.....*H. angelesianus* (No. 1) 16
15. Pileus white or whitish to cream-color..... 18
15. Pileus some shade of gray, olive or grayish brown..... 18
15. Pileus more or less yellow, tawny or cinnamon brown..... 19
16. Spores  $9-12 \times 5-7\mu$  (4-spored), stipe 3 mm. or more in dia. (a two-spored form of *H. borealis*  
may key out here).....*H. virgineus* (No. 21) 19
16. Spores  $12 \times 7\mu$ ; stipe 1-1.5 mm., cap 7 mm.....*H. niveicolor* (No. 20) 17
16. Spores smaller..... 17
17. Pileus viscid, thin and pliant.....*H. niveus* (No. 14) 17
17. Pileus not viscid (or subviscid at times), rather fleshy, usually obtuse....*H. borealis* (No. 15) 17
17. Pileus soon dry and unpolished. (*H. cremicolor* Murr. may key out here also).....  
.....*H. pratensis* var. *pallidus* (No. 22) 17
18. Spores  $4-5 \times 2.5-3\mu$ .....*H. microsporus* (No. 7) 17
18. Spores  $7-9 \times 4-5\mu$  (*H. pratensis* var. *cinereus* keys out here also)....*H. recurvatus* (No. 17) 17
19. Pileus moist but soon dry and unpolished, 2-7 cm. broad, rufous to tawny when fresh, fleshy..  
.....*H. pratensis* (No. 22) 19
19. Pileus yellow, 0.5-3 cm. broad, unpolished when dry.....*H. hudsonianus* (No. 19) 20
19. Pileus moist or viscid, somewhat membranous..... 20
20. Pileus viscid, spores  $6-8.5 \times 5-6\mu$ , stipe  $\pm$  concolorous with the pileus.....  
.....*H. colemanianus* (No. 13) 20
20. Pileus moist, hygrophanous, spores  $8-9.5 \times 4-5\mu$ , stipe white.....*H. subradiatus* (No. 16) 20

### Subgenus PSEUDO-HYGROPHORUS

Fruiting bodies with intricately interwoven gill-trama, the hyphae narrow to comparatively broad ( $5-12\mu$ ). Spores smooth, amyloid. Basidia long and flexuous and hence typical of *Hygrophorus*. The type of the subgenus and the only species known is *H. angelesianus*.

#### 1. *Hygrophorus angelesianus* sp. nov.

Pileus 2-2.5 cm. latus, convexus, denum subdepressus, glaber, viscidus, crenatus, fuscocinereus vel sordide griseus; lamellae distantes, latae, sub-decurrentes, vinaceo-cinereae; stipes 4-5 cm. longus, 3-4.5 mm. crassus, sursum fibrillose furfuraceus, deorsum glaber, sordide griseus vel deorsum albidus; sporae  $7-9 \times 4-5.5\mu$ , amyloideae.

Pileus 2-2.5 cm. broad, convex, the disc becoming slightly and shallowly depressed, the margin crenate-plicate, surface glabrous, viscid, appearing as if varnished when dry, color "hair-brown" on the disc and "drab" on the margin (dark sordid gray to grayish brown), not fading; flesh dark gray, thin, firm, odor and taste not distinctive; lamellae distant (20-24 reach the stipe, 2 tiers of short individuals), moderately broad, (3 mm.  $\pm$ ), short decurrent, "dark vinaceous drab" (purplish drab), edges even; stipe 4-5 cm. long, 3-4.5 mm. thick, slightly enlarged above, stuffed, apex fibrillose-furfuraceous, base whitish with appressed fibrils, the remainder glabrous and concolorous with the pileus; spores  $7-9 \times 4-5.5\mu$ , ellipsoid, distinctly



amyloid, smooth; basidia 42-56 (60)  $\times$  7-8 $\mu$ , slender and flexuous, four-spored; gill-trama of interwoven hyphae 5-12 $\mu$  in dia., yellowish brown in iodine, vinaceous red to haematite-red in KOH; pileus-trama homogeneous beneath a thin gelatinous pellicle, all but the pellicle dark vinaceous red in KOH, yellowish brown in iodine.

Singly, along a trail under heather on soil near Heather Park, Mt. Angeles, Olympic Mts. Wash. June 28, 1939, 6000 ft., elevation, A. H. Smith 14649—type.

This is a most peculiar species. It appears at first sight to be a typical member of the subgenus *Camarophyllus* because of its waxy consistency, long flexuous basidia and the distinctly interwoven gill-trama. However, its amyloid spores and the very distinctive reaction of the flesh and gill-trama in KOH are unique in *Hygrophorus*. The fungus bears a striking resemblance to *H. subviolaceus* both in color when fresh and in stature, but does not fade in the same manner. *H. lacmus* of Europe, also has a superficial resemblance to it, but should be readily distinguished by the yellow base of its stipe.

#### Subgenus CAMAROPHYLLUS

##### Section MICROSPORA

The species of this section are characterized by their small spores, usually under 6 $\mu$  long, and intricately interwoven gill-trama. In most of them the spores are globose to subglobose, but any with very small ellipsoid spores are also included. Four distinct lines appear to be represented, but the number of species in each is small. The species of subsection 1 are very likely more closely related to the species of subsection 3 of *Eucamarophyllus* than to the members of the other three subsections of *Microspora*.

##### 1. *Impoliti*

##### 2. *HYGROPHORUS ANGUSTIFOLIUS* Murrill.

"Pileus thick, fleshy, expanded, 4 cm. broad; surface dry, glabrous, white, margin not striate: context white, mild to the taste; lamellae long-decurrent, forking, rather crowded, narrow, white: spores minute, ellipsoid, 4  $\times$  3 $\mu$ : stipe cylindric, subglabrous, white, solid, 3 cm. long, 8 mm. thick."

The type was collected on ground in woods at Fort Lee, New Jersey, and the above description is quoted from the original account. We have the following notes from a collection found under redwood at Orick, Calif. Dec. 7, 1935 (3879-S):

Pileus 2-5 cm. broad, obtuse to plane, the disc soon depressed and margin uplifted (very similar in shape to *H. pratensis*), surface dry and unpolished, pure white, appearing innately fibrillose under a lens; flesh thick and firm, white, odor none, taste mild; lamellae decurrent, close to

crowded, narrow, thickish, very brittle, some forked, pure white, edges even; stipe 2-3 cm. long, 10-20 mm. thick, subequal, solid, glabrous or with scattered fibrils, pure white; spores  $4.5-6 \times 3-4.5\mu$ , drop-shaped to subglobose, smooth, hyaline, not amyloid; cheilocystidia and pleurocystidia none; gill-trama of narrow intricately interwoven hyphae, yellowish in iodine; basidia  $28-40 \times 5-6\mu$ , four-spored; pileus-trama homogeneous, pellicle not differentiated, yellowish in iodine.

We have been unable to locate Murrill's type, but recognize the species by the original description, and the specimens we have collected which fit it in all respects. As we have interpreted the species, it is a member of the *H. pratensis* series and distinguished from pale forms of the latter by its very small spores and close to crowded gills.

### 3. *HYGROPHORUS ALBIPES* Peck.

"Pileus convex, glabrous, grayish-brown, the margin strongly decurved; lamellae narrow, subdistant, arcuate and commonly very decurrent, whitish, becoming darker with age; stem slender, solid, glabrous, attenuated at the base, white throughout; spores subglobose or broadly elliptical,  $5-6.5\mu$  long.

"Pileus about 1.2 cm. broad; stem 2.5-3.5 cm. long, 3-5 mm. thick.

"Massachusetts, September. Dr. G. E. Francis.

"The species is related to *H. Peckii* and *H. sphaerosporus*."

The above is quoted from the original account. The type has been examined and the gill-trama found to be made up of narrow ( $4-7\mu$ ) intricately interwoven hyphae. A thin subgelatinous pellicle of hyphae  $1-2\mu$  in dia. covers the pileus. Because of this layer it is likely that the pileus is somewhat viscid when fresh. Because of the unpolished appearance of the dried specimen, however, we have placed it in this subsection. Truly viscid species usually have a somewhat varnished or polished appearance when dried. The spores are broadly ellipsoid to subglobose,  $5-6 \times 4-5\mu$ , rather than sphaeroid. The basidia are four-spored and  $38-46 \times 5-6\mu$ . Cystidia are not differentiated. When dried the specimens are tinged with yellow. *H. sphaerosporus* is quite similar, but can be distinguished by the shape of its spores and the broader hyphae of its gill-trama.

*H. Schulzeri* sensu Ricken is also very closely related and apparently differs in having a more brownish pileus and a somewhat colored stipe. In fact *H. Schulzeri* and *H. albipes* may be only forms of one species. Smith has observed differences between collections of *H. recurvatus* that were greater than those which appear to distinguish the two species in question. Since we have not seen fresh material of either, and since the differences in question should be studied from fresh specimens, we do not wish to do more than point out the resemblance at this time. For additional comments on *H. Schulzeri* see *H. microsporus*.



4. *HYGROPHORUS OBCONICUS* Peck.

"Pileus fleshy, thick in the center, obconic, convex or nearly plane, becoming depressed in the center, involute on the margin, glabrous, pruinose, white or whitish, with the center yellowish, becoming pale alutaceous with age, flesh white; lamellae thick, distant, ventricose, very decurrent, white; stem straight or flexuous, equal or tapering downward, brittle, stuffed, white; spores subglobose, .00016-.00024 of an inch long, .00016-.0002 broad.

"Pileus 6-12 lines broad; stem 10-12 lines long, 3-5 lines thick. Cespitose. Among sphagnum in swamps. Stow, Mass. September. S. Davis.

"This is allied to *H. pratensis albus* Sacc. from which it may be separated by its habitat, color and smaller spores."

We were unable to locate the type and quote the original account. The following are our notes on two collections which apparently belong here:

Pileus 1-2.5 cm. broad, convex, "light buff," hygrophanous, soon dry, pruinose to innately fibrillose, even; flesh thick on the disc, thin at margin, white, odor none, taste slightly sour; gills adnate or subdecurrent, white, slightly arcuate, broad, subdistant, venose on faces and at cap; stipe 2-4 cm. long, 2-7 mm. thick, often compressed, glabrous, concolorous with the pileus, hollow, dry; spores  $3.8-4.5 \times 2.5-3.5\mu$ , globose-ovoid, smooth; basidia  $22 \times 3.5\mu$  (hardly typical of most *Hygrophori*).

On soil, Greenbrier, Ramsey Cascades, Great Smoky Mts. National Park, A. J. Sharp, July 16, 1939 (12172-H). The second collection was from Indian Camp Creek, Great Smoky Mts. National Park, Aug. 30, 1938. The following notes were taken on it:

Pileus 15 mm. broad, convex, moist, pallid but tinged avellaneous, fading to white and appearing canescent, margin lobed; flesh white, waxy, fragile, odor and taste mild; lamellae subdistant to close, broad, broadly adnate, ventricose, pale cream color, edges even; stipe 5 cm. long, 3 mm. thick, equal, moist, glabrous, slightly longitudinally striate, concolorous with the pileus; spores  $4-5 \times 3.5-5\mu$ , broadly ellipsoid to subglobose, not amyloid, smooth; basidia  $25-28 \times 5-6\mu$ , four-spored; cheilocystidia and pleurocystidia none, gill-trama interwoven, of narrow hyphae, yellowish in iodine; pileus-trama homogeneous, no differentiated pellicle, yellowish in iodine.

The small basidia separate it from its two closest relatives in North America, *H. basidiosus* and *H. albipes*. Because the proportions of the width of the pileus to the length and width of the stipe given in the original description are those one is likely to encounter in abnormal specimens, we disregarded them in identifying our collections. The combination of ventricose and very decurrent gills is also unusual and should be studied from numerous collections before being emphasized.

5. *HYGROPHORUS BASIDIOSUS* Peck.

"Pileus rather thin, convex becoming nearly plane or centrally depressed, sometimes umbilicate, glabrous, hygrophanous, grayish brown and striatulate on the margin when moist, grayish white when dry, flesh whitish; lamellae subarcuate, thick, distant, adnate or slightly thickened at the top, glabrous, firm, solid, whitish or pallid; spores subglobose, .00016-.0002 of an inch long, basidia .0024 of an inch long, bearing spicules .0003 of an inch long.

"Pileus 1-1.5 inches broad; stem 1-2 inches long, 1-2 lines thick.

"Woods and swamps. Albany and Rensselaer counties. August. This species was formerly taken to belong to the genus *Clitocybe*, but it now appears to be a better *Hygrophorus* than *Clitocybe*. It is remarkable for the elongated basidia and sterigmata of the hymenium. It is rare but easily recognized by the peculiar grayish brown hue of the moist plant and the slight violaceous hue of the lamellae."

The above is quoted from Peck's account (14) of the New York species. The type has been examined. The cuticle of the pileus is composed of interwoven narrow ( $1-3\mu$ ) hyphae which are not truly gelatinous in KOH. In this character the species closely resembles *H. albipes*. The spores measure  $3.5-4.5 \times 3-4\mu$ , and are yellowish in iodine. The gill-trama is intricately interwoven and also yellowish in iodine. Cystidia are not differentiated. The basidia measure (30)  $38-50 \times 5-6\mu$ , and are four spored. The dried specimens are "light buff" (very pale buff) and unpolished. They have almost the same texture as dried material of *H. pratensis*. The species is very similar to *H. albipes*, from which the slightly violaceous gills distinguish it. It differs in its paler color from *H. canescens*.

6. *Hygrophorus canescens* sp. nov.

Pileus 2-4.5 cm. latus, obtusus, demum convexus, siccus et canescens, subcaeruleo-fuscus demum pallide cinereus; lamellae subdistantes vel distantes, arcuatae vel subdecurrentes, caeruleo-griseae; stipes 4-6 cm. longus, 6-8 mm. crassus, cavus, glaber et substriatus, sursum caeruleo-griseus, deorsum albidus; sporae globosae,  $4-5\mu$ .

Pileus 2-4.5 cm. broad, obtuse, becoming convex, the margin incurved and lobed or somewhat irregular, surface dry and at first canescent from a thin coating of appressed fibrils, soon becoming naked and "benzo brown" to "drab gray," moist when the hoariness has disappeared but not viscid, fading to pallid sordid gray in age, opaque at all stages; flesh concolorous with the surface (grayish), thin, fragile, odor and taste mild, no color change noted; lamellae subdistant to distant (25-32 reach the stipe,  $3 \pm$  tiers of short individuals), broadly arcuate-adnate to subdecurrent, narrow (4 mm.), broadest at point of attachment to the stipe or near it, tapering to the pileus margin, "Quaker drab," becoming "light mouse



gray" (deep bluish gray), fading when dried and then concolorous with the pileus, edges even; stipe 4-6 cm. long, 6-8 mm. thick, enlarged above, hollow, surface glabrous and somewhat longitudinally streaked, white at the base, near "pallid purplish gray" over the remainder; spores  $4-5\mu$ , globose, smooth, hyaline, not amyloid; basidia four-spored,  $44-50 \times 5-6\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of narrow ( $3-5\mu$ ) very compactly interwoven hyphae; pileus-trama homogeneous, the cuticular hyphae of the same thickness as those in the tramal body or very slightly narrower.

Singly under hemlock, Newfound Gap, North Carolina, Great Smoky Mts. National Park, Aug. 11, 1938, A. H. Smith 10031—type.

This is a very beautiful species and apparently very similar to *H. pallidus* and *H. subviolaceus*. It differs in its canescent pileus when young, dark colored stipe (the specimens were growing in deep shade) and smaller spores. In the dried condition it resembles *H. basidiosus* in appearance, but since most members of the *H. pratensis* series look much alike when dried, a great deal of emphasis cannot justifiably be placed on that resemblance. When fresh *H. basidiosus* and *H. canescens* should be readily distinguishable by the difference in the colors of the pileus and stipe and the lack of striations on the pileus of *H. canescens*.

### 7. *Hygrophorus microsporus* sp. nov.

Pileus 1-2 cm. latus, convexus demum planus, glaber, subhygrophanus, subatratus vel obscure griseus; lamellae confertae, decurrentes, angustae, pallidae; stipes 2.5-3.5 cm. longus, 2-3 mm. crassus, flexuosus, farctus demum cavus, obscure griseus, glaber; sporae  $4-4.5 \times 2.5-3\mu$ .

Pileus 1-2 cm. broad, broadly convex becoming plane, the margin regularly recurved in age, surface moist, glabrous, somewhat hygrophanous, "fuscous" (very dark gray with a tinge of brown) over all, opaque when moist, fading to "drab" or paler (medium to pale gray), somewhat atomate after losing moisture; flesh thin, fragile, waxy, dark grayish becoming pallid, taste perfectly mild, odor none; lamellae long-decurrent, close, narrow, intervenose, whitish to pallid, becoming sordid gray in age but drying much lighter than the pileus (yellowish in spots on one old individual), edges even; stipe 2.5-3.5 cm. long, 2-3 mm. thick at the apex, narrowed toward the base, flexuous, stuffed, becoming hollow, surface evenly colored and concolorous with the pileus, perfectly glabrous; spores broadly ellipsoid to nearly subglobose  $4-4.5 \times 2.5-3\mu$ , yellowish in iodine; basidia four-spored,  $26-30 \times 3.5-5\mu$ ; pleurocystidia and cheilocystidia none; gill-trama interwoven, hyphae  $6-8\mu$  in dia. (appearing subparallel in revived mounts); pileus-trama with a turf-like covering of more or less upright hyphae, the end-cells of which measure  $20-65 \times 8-20\mu$  and are clavate in shape, beneath this loose layer the flesh is compact, floccose and homogeneous; pileus-

and gill-trama and especially the hymenium, a very dull sordid yellowish brown in chloral-hydrate iodine solution.

Gregarious under aspen on sandy soil, Oakland county, Mich. Sept. 24, 1940, A. H. Smith 15455—type.

The usual iodine reaction for *Hygrophori* is a bright yellow for the gill-trama, hymenium and flesh of the pileus. The reaction for this species is strikingly different and very characteristic. The species has the stature of *H. recurvatus*, but is at once distinguished by its minute spores. It differs from *H. Peckianus* in lacking a distinctive odor and in having ellipsoid spores. The short basidia are very narrow and flexuose so that the impression one gets is that they are typical *Hygrophorus* basidia even though small. The rather tangled turf-like covering of the pileus is quite similar to that found in the *H. Cantharellus* series of species, but the pileus was not observed to become scaly and the iodine reactions of the flesh and hymenium indicate a closer relationship to *H. Peckianus*.

If one were to judge *H. Schulzeri* by Bresadola's (1) illustration, the above species might be considered a four-spored form of it. However, if one refers to Bresadola's description, certain significant differences are apparent. He described his species as "luride cinnamomeus vel brunneo cinnamomeus." These colors at once exclude our specimens and indicate that the colors as reproduced on the plate of *H. Schulzeri* are not accurate. In addition, the gills of *H. microsporus* are close instead of distant, and the stipe is glabrous.

## 2. *Odorati*

### 8. *HYGROPHORUS PECKIANUS* Howe.

Pileus 1-3 cm. broad, convex, fleshy, surface smooth (minutely fibrillose under a lens), margin even or wavy, color evenly mouse-gray (collected during dry weather); flesh whitish, fragile, odor very strong and offensive, taste slight; lamellae pallid to white at first, soon pale gray, subdistant, broad, adnate to arcuate-decurrent, thick; stipe 1-3 cm. long, 2-5 mm. thick, enlarged above and white-pruinose, mouse-color below, hollow, glabrous; spores 4-4.5 $\mu$ , globose, smooth, not amyloid; basidia four-spored; gill-trama interwoven; pileus-trama homogeneous, the surface hyphae with free ends but more or less appressed against the surface.

Scattered under aspen and bracken fern, Oakland county, Mich.

The whitish gills which become gray furnish a good character to separate this species from *H. hymenocephalus*. An interesting feature of the Michigan collection is the manner in which the ends of the hyphae forming the surface of the pileus are frequently differentiated. The end cell is somewhat oval to club-shaped, and slightly thicker than the main filament. All that is necessary here for the production of a hymeniform surface layer is for all these hyphae to produce the same type of end-cell, for these cells to



become oriented perpendicularly to the surface and enlarge somewhat. The hymenium and gill-trama of *H. Peckianus* becomes very dark rusty brown in iodine and the pileus-trama yellowish to sordid yellowish brown.



Plate 1, a. *H. Colemanianus* Bloxam.  $\times 1$ ; b. *H. paupertinus* Smith & Hesler,  $\times 1$ .

9. ***Hygrophorus paupertinus* sp. nov.** Plate 1, b.

Pileus (5) 10–20 mm. latus, subplanus, siccus, isabellinus demum umbrinus; caro cinerea, odore subnauseosa; lamellae angustae, distantes vel subdistantes, decurrentes, subcinereae; stipes 1–2 (3) cm. longus, 3–6 mm. crassus, fragilis, solidus demum cavus, isabellinus demum umbrinus, glaber; sporae 5–6  $\times$  4–5.5 $\mu$ , subgloboae.

Pileus (5) 10–20 mm. broad, convex to nearly flat, the thin margin usually becoming wavy or somewhat elevated, surface appearing dry and under a lens minutely appressed fibrillose, sometimes fibrillose-furfuraceous near the margin, color sordid Isabella-color when young but soon changing to sordid drab or dark brownish gray, sometimes fading to whitish or pallid sordid gray, flesh thin, very fragile, grayish, with an exceedingly strong penetrating disagreeable odor, taste mild, no color change noted on bruised portions; lamellae distant to subdistant, very narrow (almost fold-like in some), decurrent, pallid or pale drab; stipe 1–2 (3) cm. long, 3–6 mm. thick at the apex, usually enlarged upward, solid, becoming hollow near the apex at least, fragile, concolorous with the pileus or paler, moist, glabrous, faintly longitudinally striate from fine cracks in the cuticle; spores  $5-6 \times 4-5.5\mu$ , subglobose, smooth, yellowish in iodine; gill-trama interwoven, of narrow hyphae ( $3-5\mu$ ), lactifers present, all parts golden yellow in iodine; basidia four-spored,  $28-38 \times 5-7\mu$ ; cheilocystidia and pleurocystidia none; pileus-trama homogeneous beneath a loosely arranged fibrillose surface layer, free hyphal ends scarcely differentiated, yellow in iodine.

Gregarious on humus and soil, under redwoods, Orick, Calif. Dec. 5, 1935, A. H. Smith 3793—type.

This species resembles *H. hymenocephalus* in its color change from Isabella-color to dark brownish gray or drab, but differs in having a strong odor, and in the nature of the cuticle of the pileus. It is very close to the little known *H. Peckianus*, but differs from that species as we know it in having very narrow instead of broad gills and different colors when fresh. *H. foetans* is a somewhat similar species, but is described by Rea (15) as dark brown, becoming squamulose, and in having a squamulose stipe. Bresadola (1) illustrates *H. foetans* as having a glabrous stipe but a somewhat scaly pileus. Aside from the presence or absence of scales, *H. foetans* apparently differs from *H. paupertinus* in having much broader gills.

### 3. *Hymenocephali*

#### 10. *HYGROPHORUS HYMENOCEPHALUS* Smith & Hesler. Plate 2, b.

Pileus 5–20 (30) mm. broad, convex to hemispheric, margin incurved and usually beautifully crenate at first, becoming nearly plane in age or remaining broadly convex, the margin often becoming lobed, surface glabrous and moist when fresh, hygrophonous, "light pinkish cinnamon," "Sayal brown," "cinnamon brown," or "tawny olive" when moist and fading to "clay color" or "pinkish buff," slowly changing to darker and grayer, sometimes faded specimens darkening to "drab" and when moist to "olive brown," finally becoming "mummy brown" (dark blackish brown) over all, appearing somewhat atomate when faded; flesh thick on the disc, thin elsewhere, waxy, pallid or concolorous with the surface, odor



and taste none; lamellae broadly adnate, becoming decurrent, subdistant to distant (15-20 reach the stipe), broad, concolorous with the pileus when young, nearly so in age or "hair brown," edges pallid and even; stipe 3-8 cm. long, 2-7 mm. thick, solid but becoming hollow, tapered toward the base or nearly equal, fragile, terete or compressed, glabrous, the apex canescent at first, concolorous with the pileus and like the latter darkening in age, finally becoming "mummy brown"; spores  $4-5.5 \times 4-4.5\mu$ , globose to subglobose, not amyloid; basidia four-spored,  $34-45 \times 6-7\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of interwoven hyphae  $5-7 (16)\mu$  broad, the hymenium appearing as a blackish line in sections of old material; pileus corticated by an irregular palisade layer of inflated cells  $(30) 40-85 \times (10) 14-22 (30)\mu$ , the remainder of floccose-filamentose tissue; in iodine all tissues becoming sordid yellowish brown.

Scattered on rich humus, August, North Carolina and Tennessee. This apparently is a rather rare fungus. It seems to prefer rich humus in the dense shade of mountain laurel thickets.

**Hygrophorus atropunctus** (Bres.) comb. nov. (= *Camarophyllus atropunctus* [Bres.] Lange) also belongs to this section. It should be readily distinguished from *H. hymenocephalus* by its black-punctate stipe and in lacking the color-change so characteristic of the American species. Lange described the hyphae of the gill-trama as  $3-5\mu$  broad.

#### 4. *Pelliculosi*

##### 11. *HYGROPHORUS PALLIDUS* Peck.

Pileus (1.5) 2-5.5 (6) cm. broad, convex, becoming convex-complanate or subumbonate, sometimes plane or slightly depressed, occasionally somewhat turbinate, the margin recurved at times, surface subviscid at first but soon dry and shining and then appearing minutely fibrillose-floccose under a lens, hygrophanous, smoky violaceous or smoky lilac when fresh and moist, fading to pale gray (near "violet-gray" moist), nearly whitish at times in age, with a thin somewhat separable pellicle; flesh white to grayish or smoky violaceous near the margin, thick and firm on the disc, odor mild, taste mild at first but becoming bitterish; lamellae arcuate-adnate to decurrent, becoming strongly decurrent, narrow to moderately broad, distant to subdistant, intervenose, concolorous with the pileus when moist, becoming whitish or grayish white, edges even; stipe 3-6 cm. long, 3-8 (11) mm. thick, slender or stout, equal or narrowed downwards slightly, fibrillose or glabrous, naked at the apex, stuffed but becoming hollow, white or silvery gray; spores  $5.5-6\mu$ , globose to subglobose, not amyloid, smooth; basidia four-spored (31)  $38-44 \times 5-6\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama yellowish brown in iodine, of intricately interwoven narrow hyphae  $(3.5-8\mu)$ ; pileus-trama yellowish brown in iodine and homogeneous beneath a thin gelatinous pellicle.

Rare, on moist soil or in swampy areas, late summer and fall. Massachusetts, Tennessee and Michigan.



Plate 2, a. *H. deceptivus* Smith & Hesler,  $\times 1$ ; b. *H. hymenocepalus* Smith & Hesler,  $\times 1$ .

The smoky lilac colors of the pileus and gills, small globose to subglobose spores, gelatinous pellicle of the pileus and whitish stipe are distinctive. The small spores are its best distinction when comparing it with *H. sub-*

*violaceus*. Both have somewhat the same shades of color and fade in the same manner. *H. lacmus* of Europe apparently has about the same colors but is said to be tinted bright yellow at the base of the stipe. A critical comparative study of *H. lacmus* and *H. pallidus* should be made.

#### Section EU-CAMAROPHYLLUS

The species of this section are characterized by having medium-sized to rather large spores. The distinction that we have made between this and the preceding section is arbitrary in some respects, but in the main natural relationships are quite well represented by the subsections.

##### 1. *Viscidi*

##### 12. HYGROPHORUS SUBVIOLACEUS Peck.

Pileus 2-4 (6) cm. broad, convex-campanulate, then expanded-plane to subdepressed, hygrophanous, with a subviscid separable pellicle, "vinaceous drab" to "benzo brown" (dull violaceous grayish brown), the disc soon paler and livid, glabrous, even, margin thin and somewhat incurved at first, in age fading to pallid or whitish; flesh concolorous with the surface, moderately thick under the disc, submembranous toward the margin, odor none, taste of the moist surface of the cap markedly bitter, that of the flesh bitterish-subnauseous; lamellae arcuate then decurrent, narrow (2-4 mm.), acuminate at the ends, subdistant or distant after full expansion of the pileus, "vinaceous drab" to "benzo brown" when moist, intervenose; stipe 4-7 cm. long, 4-7 (10) mm. thick, tapering downward, flexuous below, apex often flared, stuffed or at length hollow, slightly fibrillose, glabrescent, apex naked, white or tinted by the color of the pileus; spores broadly elliptic, hyaline, smooth (6)  $7-8 \times 5-6.5\mu$ , or  $7-9 \times 6-7.5\mu$  in two-spored forms, not amyloid; basidia two- or four-spored,  $50-55 \times 6-7\mu$ ; cheilocystidia and pleurocystidia none; gill-trama of slender ( $3.5-7\mu$ ) hyphae intricately interwoven, yellowish brown in iodine; pileus-trama homogeneous beneath a thin gelatinous pellicle, yellowish in iodine; clamp connections present.

Gregarious in cedar swamps or low poorly drained soil, Ontario, Michigan, California and Washington.

Peck originally referred this species to *Limacium* and we (20) quoted his account previously. In studying our species of *Camarophyllus* we could find no significant differences between the fungus described above and Peck's species as he described it. We have not seen the type. It is also interesting to note that *H. caerulescens* has practically the same characters. It may be necessary to use the latter name instead of Peck's when the type of *H. caerulescens* has been studied microscopically. If *H. subviolaceus* and *H. caerulescens* really belong in *Limacium*, then the fungus we have described here is a new species. This was the point of view apparently upheld by Kauffman in his unpublished account of the genus. We have adopted a



more conservative attitude because it is very apparent to us that the older mycologists frequently failed to differentiate accurately between the subgenera *Limacium* and *Camarophyllus*. A parallelism such as exists between, *H. niveus* and *H. albidus* should not be assumed until proved.

The pellicle of the pileus may not always be bitter. Overholts sent us specimens from Pennsylvania which apparently had no distinctive taste but otherwise belong here. In the two-spored form from Washington, the taste was very slight. Since Peck did not mention the taste in his original account, we cannot be sure which form he had. Because of the uncertainty of this character in this instance, we have not given it the same weight that it was given in separating *H. Reai* and *H. minutulus*. Ricken's *H. Colemanianus* is very likely the two-spored form of *H. subviolaceus*. He gives the spore size as  $8-9 \times 6-7\mu$  which is exactly the same as in the two-spored form collected in Washington.

### 13. *HYGROPHORUS COLEMANIANUS* Bloxam. Plate 1, a.

Pileus 1-4.5 cm. broad, obtuse to turbinate, the margin decurved, sometimes broadly convex to nearly plane in age or with the margin recurved slightly, sometimes with a low obtuse umbo, glabrous, viscid and shining, with a thin separable pellicle, the margin translucent striate when moist, color evenly "walnut-brown" to "cinnamon brown," hygrophanous, fading to "fawn color" or "avellaneous" and finally "cinnamon buff" to "vinaaceous buff" (dull deep rusty brown fading to avellaneous or buff); flesh concolorous with the surface, thick under the disc, thin toward the margin, fragile, odor and taste mild, no color change when bruised; lamellae close to subdistant (20-26 reach the stipe), arcuate and soon distinctly decurrent, narrow to moderately broad, many forking near their outer extremities, usually one tier of short gills, "avellaneous" to "vinaaceous buff" fading to "tilleul buff" (whitish) at times, edges entire; stipe 3-6 (8) cm. long, 4-7 mm. thick, equal or narrowed toward the base, solid or with a narrow tubule, white, glabrous, not viscid, apex merely silky and not pruinose; spores  $6-8.5 \times 5-6\mu$ , ovoid to subglobose, hyaline, smooth, not amyloid; basidia  $36-48 \times 7-8\mu$ , four-spored; cheilocystidia and pleurocystidia not differentiated; gill-trama of decidedly interwoven hyphae  $5-9\mu$  in dia., basidia, subhymenium and trama all yellowish in iodine; pileustrama homogeneous beneath a thin gelatinous pellicle.

Gregarious on humus in oak and beech woods, Michigan.

The reddish brown pileus with its thin gelatinous pellicle, the white stipe and broadly ovoid spores distinguish the species. It is closely related to *H. subviolaceus*, but very easily distinguished by the color of the gills. The greatest difficulty is encountered in distinguishing *H. subradiatus*. Both have the pileus conspicuously striate when moist and fresh. The latter, as we recognize it, lacks a viscid pellicle and has a more highly colored stipe.

Our data on these species do not agree exactly with the European descriptions of either fungus, but at the same time the differences do not appear really significant. Hence we have referred the viscid species to *H. Colemanianus* and the typically moist one to *H. subradiatus*.

#### 14. HYGROPHORUS NIVEUS Fr.

Pileus 1-3 cm. broad, submembranous, obtuse to convex at first, then plane and often becoming depressed or umbilicate, hyaline white to pure white, glabrous, viscid when fresh and translucent-striate to the disc; flesh thin and pliant, white, unchanging, odor and taste not distinctive; lamellae decurrent, distant, rather narrow, white, thin, somewhat venose, edges even; stipe 2-6 cm. long, 2-4 (6) mm. thick, equal or tapered downward, stuffed, becoming hollow, somewhat striate, dry, glabrous, white; spores  $7-10 \times 4-5.5\mu$ , ellipsoid, smooth, not amyloid; basidia  $36-45 \times 5-6\mu$ , four-spored; cheilocystidia and pleurocystidia none; gill-trama of interwoven hyphae, yellowish in iodine; pileus-trama homogeneous beneath a thin gelatinous pellicle, yellowish in iodine.

Gregarious to scattered on humus in hardwood and conifer forests reported throughout eastern North America. We have seen specimens from Michigan, Tennessee, Washington and California.

This species is very close to *H. borealis* and there is some question whether the two are distinct. *H. borealis* as we know it has a moist fairly fleshy pileus whereas in *H. niveus* the pileus is thin, pliant and viscid. The translucent striations of *H. niveus* are very pronounced, but *H. borealis* may also have them and so no emphasis is placed on them here. In color, stature habit, spore size and in the interwoven gill-trama they are practically identical. Sections of the pileus of *H. borealis* show a few narrow subgelatinous hyphae over the surface, whereas those of *H. niveus* show a pellicle of appreciable thickness made up of distinctly gelatinous hyphae. In our estimation the recognition of these two species hinges on the differences noted in the pellicle of the pileus. If this proves to be a variable character, then *H. borealis* would be a synonym of *H. niveus*. We have recognized both here because our evidence points to the existence of two rather than a single species.

#### 2. *Subaquosi*

#### 15. HYGROPHORUS BOREALIS Peck.

Pileus 1-4.5 cm. broad, obtuse to convex, becoming subumbonate, plane or with the disc slightly depressed, the margin remaining decurved or spreading and somewhat undulate in age, surface moist and glabrous, somewhat lubricous at times, the margin striatulate when expanded and moist, even or wrinkled slightly after losing moisture, watery white when moist, dead white to nearly chalk-white when faded; flesh thick on the

disc, thin toward the margin, whitish, rather soft and fragile, odor and taste not distinctive; lamellae arcuate, becoming decurrent, subdistant to distant, intervenose, broadest at the base but generally narrow (4 mm. in widest part), white, edges even; stipe 2-6.5 cm. long, 2-6 mm. thick, equal or tapering to the base, stuffed, firm, glabrous or rarely innately silky, straight or flexuous, dull white; spores 7-9 (10)  $\times$  5-6.5 $\mu$ , ellipsoid, smooth, not amyloid; basidia slender (34) 48-56  $\times$  8-9 $\mu$ , two- or four-spored; cheilocystidia and pleurocystidia none; gill-trama interwoven, yellowish in iodine; pileus-trama homogeneous, with a few slender subgelatinous radially arranged hyphae as the only pellicle.

Gregarious to subcespitose in mixed hardwood and conifer forests, Nova Scotia to Washington, California and North Carolina, common and widely distributed over the continent. It fruits most abundantly during the late summer and fall but is occasionally found earlier.

Kauffman (6) described a variety which he named *subborealis* in which the spores measured 10-12 (13)  $\times$  4-5.5 $\mu$ . Kauffman's specimens have been examined and were found to be consistently two-spored. Hence we regard the variety as merely a two-spored form of the species. However, not all variation in spore size in this species appears to be caused by a variation in the number of spores born by the basidia. In coll. 10938-H (Univ. of Tenn. Herb.) the range in size is 8-12  $\times$  5-7 $\mu$ . Most of the basidia observed were four-spored and only a few two-spored individuals were seen. The number of spores measuring over 10 $\mu$  long was entirely out of proportion to the number of two-spored basidia seen. Hence it does not seem probable that all the large spores were born on these basidia.

#### 16. HYGROPHORUS SUBRADIATUS Fr.

Pileus 2.5-3 cm. broad, convex, glabrous, moist, striate nearly to the disc, hygrophanous, opaque when faded, "russet" over all moist, fading to "wood brown" more or less (dark rusty brown fading to pale dull brown); flesh concolorous to pallid (faded), thin, fragile, odor and taste mild; lamellae distant, narrow, decurrent, "fawn color" (pale vinaceous brown), edges even; stipe 5 cm. long, 4 mm. thick, equal, hollow, fragile, glabrous, concolorous with the gills above, "cinnamon drab" (gray tinged with cinnamon) below; spores 8-9.5  $\times$  4.5-5 $\mu$ , ellipsoid, hyaline, yellowish in iodine; basidia four-spored, 38-46  $\times$  8-9 $\mu$ ; cheilocystidia and pleurocystidia none; gill-trama of decidedly interwoven hyphae 6-9 $\mu$  in dia. (revived mounts), the subhymenium bright vinaceous brown (hence amyloid) in iodine, the basidia and the remainder of the trama yellow; pileus-trama homogeneous, pellicle thin and not gelatinous, small areas of the flesh near the pellicle very distinctly amyloid.

Singly on Sphagnum, Rees' Bog, Cheboygan county, Mich. Oct. 18, 1934 (1160-S).



This species is known to us from the single collection cited above. The lack of a gelatinous pellicle on the pileus, the dark colored stipe, truly ellipsoid longer spores and amyloid reaction of the subhymenium distinguish it. The specimens in question may have been frosted slightly and this might possibly account for the unusual amyloid reaction of the subhymenium. The point needs further study. In our opinion it is questionable whether *H. subradiatus* sensu Ricken belongs here. From his description it appears quite likely that his *H. Colemanianus* and *H. subradiatus* represent the two- and four-spored forms of one species. For additional comments on his *H. Colemanianus* see *H. subviolaceus*.

17. *HYGROPHORUS RECURVATUS* Peck.

Pileus 1-2.5 (3) cm. broad, obtuse to convex at first, in age plane, sometimes with a recurved margin, sometimes with a depressed disc, with or without a papilla, surface lubricous to subviscid when wet, the disc rugulose or smooth, at times faintly translucent-striate on the margin, margin either wavy or subpiculate, cuticle often cracking circumferentially in age and at times lacerate, "clove-brown" "olive-brown" or "buffy brown" (dark or pale olive-brown), margin paler in age (pale olive-brown); flesh thin, dark olive-brown, fragile, odor and taste not distinctive; lamellae distant to subdistant, decurrent, broad, grayish white; stipe 2-4 cm. long, 3-6 mm. thick at the apex, tapering slightly downward, solid, grayish within, whitish or concolorous with the pileus, glabrous, moist, occasionally faintly longitudinally striate; spores  $7-9 \times 4-5\mu$ , ellipsoid, yellowish in iodine; basidia four-spored,  $42-53 \times 6-8\mu$ ; cheilocystidia and pleurocystidia none; gill-trama of narrow very decidedly interwoven hyphae; pileus-trama homogeneous beneath a very thin gelatinous pellicle.

Gregarious under conifers and in pastures, New York, Washington, Oregon and California during wet fall months.

The species is very common in the pastures and grassy areas of northern California. In the Oregon collections the stems were white. These were collected in a shady place. The collections from open fields had darker pilei and darker colored stipes. The gelatinous pellicle is so thin that it can be easily overlooked or lost in sectioning either fresh or dried specimens. It does not appear to be sufficiently well developed to cause fresh wet specimens to be truly viscid.

3. *Impoliti*

18. *HYGROPHORUS CREMICOLOR* Murrill.

"Pileus convex to expanded, umbonate, solitary, 2.5 cm. broad; surface moist, not viscid, glabrous, smooth, uniformly cream-colored; lamellae decurrent, arcuate, distant, bright yellowish white; spores ovoid, pointed at one end, smooth, hyaline,  $5-6 \times 4.5-5\mu$ ; stipe fleshy, subequal, smooth, glabrous, cremeous, 5 cm. long, 7 mm. thick.

"Type collected on the ground in woods at Seattle, Washington, Oct. 20-Nov. 1, 1911. W. A. Murrill 568."

Macroscopically, in the dried condition, the type is indistinguishable from *H. basidiosus*. A microscopic study of the type was made by Dr. Rolf Singer who very kindly communicated the following information to us in his letter of April 5, 1941. "Spores smooth, hyaline, not amyloid,  $6.5-8.5 \times 3.3-4.8\mu$ . Basidia  $44-53 \times 4.3-5.3\mu$ . Gill-trama of hyphae interwoven in all directions. Hyphae of the surface of the pileus subparallel-interwoven, not mucilaginous, with numerous clamp connections. These indications show, in my opinion, that it is a true *Camarophyllus*."

The spores separate this species from *H. albipes* and *H. basidiosus*, but since they are very similar in size to those of *H. pratensis*, one is inclined to wonder if Murrill's species is more than a slender pallid specimen of the latter. The senior author has encountered such forms of *H. pratensis* along the west coast, but never found their gills to be "bright yellowish white." It is on the basis of this character more than any other, that we tentatively recognize the species. The similarity of *H. Karsteni* f. *minor* Bres. to *H. cremicolor* is very striking. However, *H. Karsteni* of other European authors is a *Limacium*. Bresadola's specimens should be studied to determine whether or not they belong in *Limacium*.

#### 19. *HYGROPHORUS HUDSONIANUS* Jennings.

"General color, a dull corn yellow. Pileus 0.5-3.0 cm. broad, plane or centrally and marginally depressed, glabrous but not shining, fading to a pale yellow when dry, viscid and rubbery-cartilaginous when moist. Gills sub-arcuate, strongly decurrent, distant, intervenose, wide, thick, waxy, when dry not fading so much as does the pileus. Stem about 1-2.5 cm. long, 1.5-2 mm. thick, straight or curving upwards, cartilaginous, hollow, when dry pale yellow to almost white, dull, minutely powdery puberulent, slightly enlarged and matted with white cobwebby mycelium at the base. Spores elliptical,  $4-5 \times 5-8\mu$ , smooth, hyaline, rather thin-walled.

"Collected by Dr. George M. Sutton, Southampton Island, 1930.

"Type in the Carnegie Museum Herbarium.

"When moistened the fungus quickly revives and becomes cartilaginous and viscid, soon taking on a dark umber color which is retained when the fungus is again dried. The plants arise from the brown peaty portions of tufts of the moss *Dicranum fuscescens*. The species seems nearest to *Hygrophorus nitidus* Berkeley & Curtis (*Hydrocybe nitida* Murrill), but it differs from the latter species in having a plane or depressed pileus and a puberulent stem."

The above is quoted from the original account. Judging from the portion of the type which we examined, the stature of the species is almost identical with that of *H. ceraceus*. Its consistency, however, is much firmer. The

puberulence of the stipe is very conspicuous under a lens, and under a microscope is found to be caused by numerous projecting undulating hyphae up to  $150\mu$  long and  $8-10\mu$  thick. The pileus-trama is perfectly homogeneous and the hyphae measure  $6-8\mu$  in dia. No lactifers were seen. The gill-trama is very intricately interwoven. Its hyphae measure  $3-6\mu$  in dia. No cystidia were seen on the sides and edges of the lamellae. The basidia are four-spored and measure  $38-44 \times 6-7\mu$ . The spores are smooth, not amyloid, and measure  $7-8 \times 3.5-5\mu$ . The iodine reaction of the flesh of the pileus, gill-trama and hymenium is yellowish brown.

We are inclined to regard the viscosity mentioned by Jennings as a false viscosity caused by the somewhat resinous feel of the dried specimens. At least we were unable to demonstrate any gelatinizing layers of tissue in our mounts. The dried specimens have the unpolished appearance of members of the *H. pratensis* series, but are even firmer in their consistency. We have not, of course, seen fresh material.

20. **Hygrophorus niveicolor** (Murr.) comb. nov.

(=*Clitocybe niveicolor* Murrill, Mycologia, 3: 190. 1911.)

"Entire hymenophore snow-white, gregarious: pileus compressed-convex reaching 7 mm. in diameter; surface smooth, glabrous, appearing sub-tomentose when dry because of the loosely woven context, margin slightly irregular, decurved: lamellae decurrent, distant, slightly arcuate: spores ovoid, smooth, hyaline,  $12 \times 7\mu$ : stipe cylindric, slightly tapering upward, glabrous, fleshy, fistulose, 1-1.5 cm. long, 1 mm. thick above, 1.5 mm. below."

Apparently known only from the type locality, Motozorongo, Mexico. We have quoted the description given by Murrill in the North American Flora. Dr. Rolf Singer has studied the type and communicated the following information to Smith in a letter of April 27, 1941. The species is a *Camarophyllus* with large spores on four-spored basidia. The gill-trama is typical of *Camarophyllus* and clamp connections are present.

21. **HYGROPHORUS VIRGINEUS** Fr.

Pileus 3-6 (8) cm. broad, white, at first moist, later dry and becoming rimose, finally somewhat fibrillose and becoming yellowish over the disc, at first convex and usually weakly umbonate, later nearly plane or finally slightly depressed, margin incurved at first, later nearly plane, margin thin, central portion rather fleshy; flesh white, soft, watery, odorless or with a slight pleasant odor, taste mild; lamellae 3-5 (7) mm. broad, white, rather thick, distant, venose, decurrent; stipe short, 2.5-6 cm. long, 5-12 mm. thick, white smooth, glabrous, sometimes pruinose, narrowed below, often flaring above, frequently crooked, solid at first, later stuffed; spores  $9-12 \times 5-7\mu$ , cylindric-elliptic, basidia  $42-60 \times 6-8\mu$ .



Murrill reported the species throughout eastern and northern North America. Hesler has found it in Tennessee.

Kauffman's report for Michigan appears to be based on a white form of *H. pratensis* and certain European authors have also considered *H. virgineus* to be merely a white *H. pratensis*.

## 22. HYGROPHORUS PRATENSIS Fr.

Pileus 2-7 (10) cm. broad, obtuse to convex and soon more or less expanded, broadly convex to umbonate or turbinate in age, glabrous when moist but soon becoming dry and unpolished (minutely fibrillose under a lens), often areolate or irregularly cracked around the disc, "rufous" to "zinc orange" when young and moist and becoming "cinnamon rufous," fading slowly to "light ochraceous buff" or remaining some shade of pale tawny (colors rather bright ferruginous brown or reddish when young, gradually becoming paler and more tawny brown and in age becoming pale or moderately dark buff); flesh thick, brittle, whitish or pale fulvous, odor and taste mild; lamellae decurrent, distant, thick, narrow to moderately broad (3-4 mm.), more or less concolorous with the pileus or paler ("apricot buff" then "salmon buff," finally pallid), usually intervenose; stipe 3-7 (9) cm. long, (3) 6-12 (15) mm. thick, usually tapered toward the base, sometimes nearly equal, fleshy, stuffed, dry and unpolished, glabrous, even, whitish or tinged like the pileus; spores  $6-8 \times 4-5\mu$ , ellipsoid to sub-ovoid, smooth, not amyloid; basidia (32)  $40-53 \times 5-7.5\mu$ , four- or two-spored; cheilocystidia and pleurocystidia not differentiated; gill-trama yellow in iodine and homogeneous, pellicle not differentiated.

Solitary, gregarious or caespitose, in open places, on grassy areas, in thickets or dense forests, common throughout the United States and Canada. It is very common in the redwood groves of northern California.

Kauffman (6) listed a var. *pallidus* and a var. *cinereus*. We have not seen the latter, but the former is occasionally encountered throughout the range of the species in North America. Since the species is very common and does not decay very rapidly, one frequently encounters old faded specimens which are in good condition and which might lead one to think he had one of the typically pale forms.

## Subgenus HYGROCYPE

### KEY TO SPECIES

1. Neither pileus nor the stipe viscid (Section *Pseudo-Camarophyllus*).....2
1. Pileus viscid, stipe moist or dry but not viscid (Section *Eu-Hygrocype*).....30
1. Both pileus and stipe viscid or glutinous (Section *Viscidipedes*).....47
2. Pileus sharply conic to conic-campanulate.....3
2. Pileus obtusely conic, convex or depressed on the disc.....7
3. Pileus white, with a long cylindric umbo.....*H. alboumbonatus* (No. 48)
3. Pileus some other color.....4

4. Pileus pale yellow, spores angular *H. Graciae* (see excluded species).....91
4. Spores not angular (smooth and ellipsoid).....5
5. Fruiting body blackening when bruised or in age.....*H. conicus* and forms (No. 52)
5. Fruiting body not blackening.....6
6. Pileus yellow.....*H. subflavidus* (No. 51)
6. Pileus bright to rusty pink.....*H. amoenus* (No. 49)
6. Pileus greenish to yellowish brown spores 9-11 $\mu$  long.....*H. immutabilis* (No. 50)
6. Pileus with olive tints, spores 6-8 $\mu$  long.....*H. marginatus* var. *olivaceus* (No. 36)
7. Pileus squamulose or becoming so when faded or in age.....8
7. Pileus remaining glabrous when faded (weathered specimens may be rimose or irregularly cracked in age).....16
8. Pileus scarlet to deep brilliant red when young, fading quite readily, usually to yellow or orange.....9
8. Pileus rufous to tawny or bright orange to orange-yellow or some shade of yellow to yellowish brown when young.....12
8. Pileus pallid brownish, becoming gray or grayish.....15
9. Spores 10-14 $\mu$  long (4-spored); nearly always found in Sphagnum bogs.....*H. miniatus* var. *sphagnophilus* (No. 25)
9. Spores smaller.....10
10. Lamellae arcuate to distinctly decurrent when young.....*H. Cantharellus* (No. 26)
10. Lamellae adnate to adnexed, sometimes subdecurrent.....11
11. Flesh rather thick and firm.....*H. miniatus* var. *firmus* (No. 23)
11. Flesh thin and brittle.....*H. miniatus* (No. 24)
12. Cheilocystidia abundant, filamentous, 100-120 $\times$ 4-5 $\mu$ .....*H. fimbriatophyllus* (No. 29)
12. Cheilocystidia not differentiated.....13
13. Spores 8-9 $\times$ 4-5 $\mu$ , pileus brilliant yellow to orange.....*H. mollis* (No. 28)
13. Spores 10-13 $\times$ 6-8 $\mu$ , pileus yellow.....*H. turundus* (No. 27)
13. Pileus dull olive yellowish brown or cinnamon rufous to tawny.....14
14. Pileus cinnamon rufous to tawny, taste astringent and bitter.....*H. Cokeri* (No. 31)
14. Pileus dull olive yellowish brown, scales brownish; fruiting bodies usually caespitose.....*H. caespitosus* (No. 30)
15. Odor distinctly nitrous when fruiting body is fresh.....*H. nitratus* (No. 32)
15. Odor not nitrous, flesh turning pinkish when bruised.....*H. ovinus* (No. 33)
16. Odor distinctive, mephitic.....*H. mephiticus* (No. 44)
16. Odor not distinctive.....17
17. Spores globose to subglobose.....18
17. Spores ovoid to ellipsoid.....23
18. Spores 6-7 $\mu$  in dia.....19
18. Spores up to 5 $\mu$  in dia.....20
19. Pileus pale reddish yellow, lamellae crowded.....*H. Earlii* (No. 41)
19. Pileus whitish, inclining to reddish brown, lamellae subdistant (but appearing close in dried plants).....*H. sphaerosporus* (No. 45)
20. Pleurocystidia and cheilocystidia present, pileus white.....*H. subaustralis* (No. 47)
20. Cystidia absent (as far as is known).....21
21. Pileus aurantiacus.....*H. aurantius* (No. 39)
21. Pileus cinnamon brown to dull yellow brown when moist.....*H. deceptivus* (No. 46)
21. Pileus luteous.....22
22. Lamellae nearly free.....*H. flavoluteus* (No. 66)
22. Lamellae adnate with a decurrent tooth.....*H. subflavidus* (No. 51)
23. Spores large, 10-18 $\mu$  long.....24
23. Spores up to 11 $\mu$  long.....25
24. Spores 10-13 $\times$ 7-9 $\mu$ , lamellae white stained with red.....*H. roseus* (No. 42)
24. Spores 18 $\times$ 10 $\mu$ ; lamellae yellow tinged with orange.....*H. bellus* (No. 43)
25. Lamellae brilliant orange to salmon-orange, not fading and brighter than the pileus in age.....*H. marginatus* (No. 35)
25. Lamellae paler than the pileus, soon fading.....26
26. Pileus red or orange-red.....27

26. Pileus some other color . . . . . 28
27. Lamellae orange-red to yellowish orange; stipe short (forms of *H. miniatus* may key out here).  
     . . . . . *H. coccineus* (No. 34)
27. Stipe long (10–12 cm.), fruiting bodies caespitose . . . . . *H. Ravenelii* (No. 53)
27. Lamellae white to pale yellow . . . . . *H. subcespitosus* (No. 40)
28. Pileus greenish brown to yellowish brown . . . . . *H. immutabilis* (No. 50)
28. Pileus pale to bright yellow . . . . . 29
29. Lamellae broadly adnate, pileus conic to convex, stipe 1–1.5 mm. thick . *H. mycenoides* (No. 38)
29. Lamellae decurrent, cells of gill-trama 10–20 $\mu$  in diameter . . . . . *H. parvulus* (No. 37)
29. Lamellae decurrent, cells of gill-trama 3–6 $\mu$  in diameter . . . . . *H. hudsonianus* (No. 19)
30. Pileus distinctly conic or with a prominent conic umbo . . . . . 31
30. Pileus plane, convex, obtuse or obtusely conic, if umbonate the umbo obtuse . . . . . 35
31. Fruiting body blackening more or less when bruised or upon aging (*H. Ravenelli* sensu Coker  
     keys out here also) . . . . . *H. conicus* and forms (No. 52)
31. Fruiting body not blackening in any part . . . . . 32
32. Large cystidia scattered on sides and edges of the gills, pileus a delicate rose or pink color .  
     . . . . . *H. amoenus* (No. 49)
32. Cystidia not differentiated . . . . . 33
33. Pileus bright red . . . . . *H. cuspidatus* (No. 54)
33. Pileus gray to putty-color . . . . . *H. acutus* (No. 57)
33. Pileus yellow or yellowish (faded forms of *H. cuspidatus* (No. 54) will key out here) . . . . 34
34. Odor disagreeable (slight to strong), lamellae broadly adnate with a decurrent tooth . . . .  
     . . . . . *H. auratocephalus* (No. 55)
34. Odor not distinctive, spores 9–12 $\times$ 4.5–6 $\mu$  . . . . . *H. Langii* (No. 56)
34. Odor not distinctive, spores 7–8 (9) $\times$ 5–5.5 $\mu$ ; gills nearly free. A form of *H. Langii* (No. 56)
35. Pileus white, gray or fuscous at least on the disc . . . . . 36
35. Pileus yellow, ferruginous to bright red . . . . . 39
36. Pileus white . . . . . 37
36. Pileus gray or fuscous at least on the disc . . . . . 38
37. Spores 9–12 $\times$ 5–6 $\mu$ , stipe short and thick . . . . . *H. brevipes* (No. 58)
37. Spores 7–9 $\times$ 5–6 $\mu$ , stipe slender . . . . . *H. huronensis* (No. 59)
38. Spores globose . . . . . (see Smith & Hesler, 20). *H. subulridus*
38. Spores ellipsoid . . . . . *H. fornicatus* (No. 67)
39. Pileus yellow . . . . . 40
39. Pileus ferruginous to bright red . . . . . 43
40. Spores globose . . . . . *H. flavoluteus* (No. 66)
40. Spores not globose . . . . . 41
41. Spores 5 $\times$ 2.5 $\mu$  . . . . . *H. subceraceus* (No. 65)
41. Spores broader . . . . . 42
42. Gills adnexed . . . . . *H. flavescens* (No. 60)
42. Gills arcuate-adnate, becoming short decurrent (*H. parvulus* may also key out here) . . . .  
     . . . . . *H. ceraceus* (No. 69) *H. nitidus* var. *luteus* (No. 71)
43. Pileus ferruginous, lamellae violaceous . . . . . *H. trojanus* (No. 64)
43. Pileus bright red, lamellae not violaceous . . . . . 44
44. Lamellae decurrent . . . . . *H. subminiatus* (No. 63)
44. Lamellae adnexed to adnate . . . . . 45
45. Pileus with a readily demonstrable gelatinous pellicle . . . . . 46
45. Pileus without a distinct pellicle . . . . . *H. coccineus* (No. 34)
46. Stipe white or merely splashed with yellow or red at the base . . . . . *H. laetissimus* (No. 62)
46. Stipe  $\pm$  concolorous with the pileus . . . . . *H. puniceus* (No. 61)
47. Pileus bright parrot green, soon yellowish or rufous, stipe usually remaining greenish near the  
     apex . . . . . *H. psittacinus* (No. 75)
47. Colors not as above . . . . . 48
48. Colors mixed and variable, yellowish, pinkish, olivaceous or grayish violaceous . . . . . 49
48. Colors not as above (bright but  $\pm$  monochromatic) . . . . . 50
49. Fruiting body pinkish when dried . . . . . *H. laetus* (No. 73)
49. Fruiting body dull yellow when dried . . . . . *H. hondurensis* (No. 74)



50. Pileus pure white, conic.....*H. purus* (No. 76)  
 50. Pileus differently colored.....51  
 51. Pileus dominantly bright or dull yellow.....52  
 51. Pileus dominantly red.....55  
 51. Pileus dominantly fuscous to grayish or grayish brown.....58  
 52. Stipe white, gills brilliant orange yellow and not fading.....*H. flavifolius* (No. 72)  
 52. Stipe and gills  $\pm$  concolorous with the pileus.....53  
 53. Pileus soon deeply depressed, lemon yellow, fading to whitish.....*H. nitidus* (No. 70)  
 53. Pileus not fading to whitish, often depressed (*H. hondurensis*, No. 74, which may fade to whitish may key out here also).....*H. ceraceus* (No. 69)  
 53. Pileus conic or very slightly depressed.....54  
 54. Pileus obtuse or only slightly depressed, lamellae adnexed, becoming emarginate.....*H. chlorophanus* (No. 68)  
 54. Pileus conic or conic umbonate.....*H. subruber* (No. 79) and *H. Ravenelii* sensu Coker (No. 53)  
 54. Pileus obtuse, gills decurrent.....*H. nitidus* var. *luteus* (No. 71)  
 55. Pileus conic; spores 6-8 (9)  $\times$  4-5 $\mu$ .....*H. ruber* (No. 77)  
 55. Pileus conic, spores 9-12 (16)  $\times$  6-8 $\mu$ .....*H. persistens* (No. 78)  
 55. Pileus obtuse or flattened.....56  
 56. Pellicle bitter, pileus scarlet, fading to orange.....*H. Reai* (No. 81)  
 56. Pellicle not bitter.....57  
 57. Pileus bright red, fading to orange.....*H. minutulus* (No. 82)  
 57. Pileus watery reddish orange to ferruginous.....*H. sciophanus* (No. 80)  
 58. Odor faintly subaromatic to disagreeable.....*H. unguinosus* var. *subaromaticus* (No. 84)  
 58. Odor not distinctive (*H. luridus* keys out here also).....*H. unguinosus* (No. 83)

### Section PSEUDO-CAMAROPHYLLUS

The species of this section show considerable variation in the arrangement of the hyphae of the gill-trama. In some it is quite regular or parallel and in some quite interwoven. Generally speaking, the cells are broad. This justifies including the group in *Hygrocybe* rather than *Camarophyllus*. The squamulose condition of the pileus is best observed on faded specimens. When moist, members of the first subsection may appear glabrous.

#### I. *Squamulosi*

##### 23. *Hygrophorus miniatus* var. *firmus* nom. nov.

(=*Hygrophorus squamulosus* Ellis & Ev., Proc. Acad. Phila. 1893: 440. 1894.)

Pileus 1.5-5 cm. broad, obtuse to convex, the disc often slightly depressed, the margin incurved, surface dry or only slightly moist, glabrous when young but very soon breaking up into minute or distinct fibrillose scales especially near the margin, color "flame scarlet" to "orange chrome" (bright red to brilliant orange-yellow), margin yellowish at times, fading throughout to "ochraceous-salmon," finally becoming bright yellow over all; flesh thick and firm, concolorous with the surface and fading to yellow, odor and taste not distinctive; lamellae bluntly adnate or with a slight decurrent tooth, seceding quite readily, close to subdistant (18-22 reach the stipe, 2-3 tiers of short individuals), broad (4-6 mm), thick, reddish to pale yellow, edges even; stipe 3-5 cm. long, 3-6 mm. thick, frequently

compressed, equal, hollow, apex white-pruinose, glabrous elsewhere, "apricot-yellow" or tinged with red, concolorous within except for the white pith; spores  $6.5-8 \times 4-5\mu$ , subellipsoid, smooth, not amyloid; basidia  $30-32 \times 5-6\mu$ , four-spored; cheilocystidia occasional,  $50 \times 6\mu$ ; pleurocystidia none; gill-trama of parallel to subparallel hyphae, yellowish in iodine; pileus-trama homogeneous beneath a turf-like covering of upright or sub-appressed hyphae, yellowish in iodine.

Scattered to gregarious, particularly around rotten stumps and very rotten logs. Material has been examined from Ontario, Canada, and Michigan and Pennsylvania in the United States. It apparently fruits during fairly dry seasons in the late summer and fall.

This fungus was recognized by Smith (19) as a species, but additional collections since that time have emphasized its resemblance to *H. miniatus*. The cheilocystidia noted in the above description are not numerous enough to be of any service in distinguishing the variety since they are so rare that one often has to examine many sections to demonstrate them. The parallel gill-trama of rather narrow ( $7-10\mu$ ) hyphae may be somewhat more distinctive, but we doubt it. We are inclined to explain this character and also the firmer consistency on the basis that they are secondary characters resulting from the dry conditions under which the fruiting bodies were produced.

#### 24. *HYGROPHORUS MINIATUS* Fr. var. *TYPICUS*.

Pileus (1) 2-4 cm. broad, broadly convex with an incurved margin when young, remaining broadly convex in age or becoming plane, the disc often depressed or slightly umbilicate, brilliant scarlet when moist and then appearing glabrous, almost hygrophanous, fading to orange or even pale yellow and then the surface appearing minutely fibrillose-scurfy, appearing matted-fibrillose when viewed under a lens, not translucent striate when moist or occasionally very slightly so along the thin expanded moist margin, occasionally slightly rimose in age or when dried; flesh thin, brittle, waxy, concolorous with or paler than the surface, varying from scarlet to orange or pale yellow, taste mild or 'slightly earthy, odor not distinctive, no color changes evident on bruised portions; lamellae close to subdistant (28-34 reach the stipe, 1-2 tiers of shorter individuals), broad (5-9 mm.), becoming ventricose, bluntly adnate but becoming broadly adnexed, almost concolorous with the pileus but fading sooner to orange or yellow, the edges eroded; stipe 3-5 cm. long, 3-4 mm. thick, rather narrow for the width of the pileus, equal, stuffed with a yellow pith, the cortex orange, surface glabrous or in faded specimens faintly fibrillose, concolorous with the pileus and fading slowly, hence usually more reddish than the faded pilei; spores  $7-9 \times 4-5\mu$ , ellipsoid (a few apparently abnormal spores shaped  $\pm$  like corn kernels are sometimes found), smooth, not amyloid;

basidia 40–6 $\mu$ , four-spored; pleuro- and cheilocystidia not differentiated; gill-trama subparallel, the hyphae with long cylindric cells; pileus-trama homogeneous, the cuticular hyphae not appreciably narrower but with free ends (which cause the furfuraceous appearance of faded specimens), clamp connections abundant.

Gregarious to scattered on soil containing a great deal of lignicolous debris or on logs almost reduced to humus. Sometimes quite abundant on muck-soil in swamps which have become partly dried out. Common during the summer and fall.

Hesler has taken the following color notes on specimens from Tennessee: Pileus "dragon's blood red," "scarlet red," "flame scarlet," "rufous," "ochraceous orange," "orange," "pinkish buff," or "salmon buff," fading to "light orange-yellow" or paler. Lamellae "ochraceous buff" to "apricot orange." In general it may be said that the colors are variable. It is not always possible to determine whether one has truly fresh material or specimens that have been remoistened.

The attachment of the gills also varies considerably. One would naturally think that a mushroom with adnexed ventricose gills was distinct from one in which the gills were truly decurrent. On this character the specimens of no. 15449-S (the collection upon which the above description is based), might be referred to *H. miniatus* var. *congelatus* Pk. since Peck gave the gill attachment as subemarginate for his variety. However, after studying many collections we are inclined to doubt the validity of maintaining such a distinction. The gills of the species are typically bluntly adnate. From this condition they may become ventricose and adnexed if the pileus does not expand completely, or subdecurrent if it does.

*Hygrophorus constans* Murrill was said by its author to retain its red color on drying and thereby be distinct from *H. miniatus*. In Oregon Smith has collected specimens answering to Murrill's description but was unable to distinguish them from *H. miniatus*. The type of *H. constans* has been studied and no distinctive characters found. The pileus-trama and the hyphae forming the surface-covering of the cap are similar to those of *H. miniatus*. As a result of the above observations we consider *H. constans* to be synonymous with *H. miniatus*.

## 25. HYGROPHORUS MINIATUS var. SPHAGNOPHILUS Peck.

Pileus 1–3.5 cm. broad, broadly convex or flattened when very young, soon becoming broadly depressed over the disc, the margin long remaining decurved and frequently becoming scalloped or wavy, in age the margin sometimes spreading and the disc deeply depressed, surface dry and minutely and densely floccose at least on the disc or in the depression, usually becoming somewhat scaly, color at first vermilion red ("nopal red") to scarlet, fading to yellow or brownish orange, the tips of the scales often



darkening somewhat; flesh thin or fairly thick, soft, concolorous with the pileus, odor and taste mild; lamellae at first adnate, remaining so or becoming deeply decurrent, distant (9-15 reach the stipe, 2 tiers of short individuals), color variable, sometimes concolorous with the pileus (red or orange), sometimes pallid or faintly yellow, at times forked near the margin, edges even; stipe (3) 5-13 cm. long, 1-3 (4) mm. thick, equal, usually flexuous, stuffed solid but becoming tubular, fragile, glabrous or silky, not viscid, vermilion-red or yellowish, whitish where buried in the moss; spores (9)  $10-14 \times 7-9$  (10.8) $\mu$  subellipsoid to subreniform, smooth, not amyloid; basidia  $41-68 \times 7-10\mu$ , four-spored; cheilocystidia and pleurocystidia not differentiated; gill-trama of subparallel to interwoven hyphae, the cells  $12-32 \times 7-12\mu$ , yellowish in iodine; pileus-trama homogeneous beneath a turf-like covering of the surface hyphae which have slightly clavate end-cells but do not form a palisade, all tissues yellowish in iodine, in water mounts of fresh specimens the cells of the flesh and gill-trama are filled with a bright orange fluid.

Gregarious to scattered in sphagnum bogs throughout northern and eastern United States and Canada. Singer has collected it in Europe. We have examined material from Singer deposited in the Univ. of Mich. Herbarium. North American specimens from North Carolina, Michigan, Ontario and New York have been studied.

This variety is very distinctive both because of its habitat and large spores. Kauffman in his unpublished manuscript referred it to *Hygrocybe* because of its parallel gill-trama. Neither of us have been able to demonstrate the constancy of this character. In most mature or old individuals the trama is quite interwoven and in this respect resembles that of *H. Cantharellus*. Singer (18) believes that the form of *H. turundus* occurring in the sphagnum bogs of Europe is identical with *H. miniatus* var. *sphagnophilus*. Most descriptions of *H. turundus*, however, do not fit Peck's variety. The terms *fuchsige* or *tawny reddish* do not describe the colors of the stipe in our material. Rea (15) described the pileus as yellow or tawny, again colors which could apply only to faded specimens of the American fungus.

## 26. *HYGROPHORUS CANTHARELLUS* Schw.

Pileus 1-3 (3.5) cm. broad, convex to flattened on the disc when young, becoming broadly convex-umbilicate at maturity or sometimes the disc not depressed, sometimes the margin spreading or recurved and the cap then appearing broadly infundibuliform, surface dry, silky at first and then inately finely lacerate squamulose especially around the disc or in the depression, color variable, "flame scarlet," "ochraceous orange," or "orchraceous buff" brighter when young, paler in age (bright red gradually becoming yellow), margin even, scalloped or wavy; flesh thin (2 mm.  $\pm$ ) on the disc, thinner at the margin, reddish orange or yellow, odor and taste mild; lamellae decurrent (usually long-decurrent), subdistant to distant,

broad but acuminate on the stipe, orange to yellow (usually paler than the pileus), edges even; stipe (2) 4-9 (12) cm. long, 1.5-4 (5) mm. thick, equal or slightly enlarged above, terete to subcompressed, fragile, stuffed to hollow, glabrous dry, concolorous with the pileus or paler, base whitish or pallid yellowish; spores (7) 8-10 (11)  $\times$  4-6 $\mu$ , 8-12  $\times$  5-7 $\mu$  in two-spored forms, ellipsoid to subvoid, not amyloid; basidia (35) 45-55  $\times$  6.5-8 (10) $\mu$  two- or four-spored; cheilocystidia and pleurocystidia not differentiated; gill-trama of subparallel to interwoven hyphae, the cells 60-159  $\times$  12-36 $\mu$ , and usually filled with yellowish contents; pileus-trama homogeneous beneath a turf-like covering of hyphae with their free ends projecting, all parts yellowish in iodine.

Gregarious to subcespitose on rich humus in moist woods or in partly dried up bogs, often very abundant in bogs during very dry years. Summer and fall, throughout eastern North America.

This species differs from *H. miniatus* in its more slender stature, decurrent gills, paler color and drier pileus. Kauffman in an unpublished manuscript had arranged *H. Cantharellus* in *Camarophyllus* and *H. miniatus* in *Hygrocybe*. Both species are too closely related to allow for their arrangement in different subgenera. Furthermore, there are many intermediate forms. The spore size of *H. Cantharellus* and *H. miniatus* var. *sphagnophilus* intergrade somewhat. We have not recognized most of the intergrading forms because many are known from single collections, and we believe these merely represent differences between collections rather than between taxonomic units. Hesler, No. 12788, collected a form of *H. Cantharellus* at Indian Creek, N. C., in the Great Smoky Mts. National Park which has spores 9-12  $\times$  5-7 $\mu$  on four-spored basidia and scattered cheilocystidia and pleurocystidia 40-60  $\times$  9-15 $\mu$ . The cystidia project only slightly from the hymenium and are very difficult to demonstrate. This form may deserve recognition when more is known of it.

## 27. HYGROPHORUS TURUNDUS Fr.

Pileus 1-2 cm. broad, convex-turbinate, obtuse, "apricot yellow" (rich yellow), not fading, at first covered by a minute loose innate white silkiness, later fibrillose-subtomentose, moist, even, margin decurved; flesh pale yellowish to whitish; odor and taste none or very slight; lamellae arcuate-decurrent, distant, broad, white, sometimes creamy-tinted; stipe 3-5 cm. long, 1.5-3 mm. thick, equal, solid, terete, glabrous, naked at apex, even, rufous, scarcely paler at the base; spores broadly ellipsoid, smooth, obtuse, hyaline, not amyloid, 10-12  $\times$  5-7.5 $\mu$ ; basidia four-spored, 46-60  $\times$  8-9 $\mu$ ; gill-trama subparallel; pileus-trama homogeneous beneath a turf-like covering of surface hyphae.

Gregarious, on the ground along a road in a woods of hardwoods, Ann Arbor, July 8, 1924, C. H. Kauffman.

The species is very near *H. Cantharellus* but is separated by its whitish

gills, yellow colors and slightly larger spores. Kauffman had tentatively considered it to be undescribed, but in our estimation it is better to place it in *H. turundus*. As for many agarics, *H. turundus* has been variously described by many different investigators all of whom had fungi very similar to Kauffman's but differing in some detail. In Ricken's (17) description the spore size is given as smaller than in Kauffman's. Rea (15) gives the size as  $8-11 \times 5-6\mu$ . *H. turundus* var. *lepidus* Boud. is also close, but Boudier's illustration is very suggestive of *H. Cantharellus*.

28. *HYGROPHORUS MOLLIS* (Berk. & Br.) Kauff.

"Pileus 5-12 mm. broad, at first discoid, then broadly convex, obtuse, moist, "mikado orange" (R), decorated by fine, pointed, concolorous fascicles of fibrils which suggest a minutely echinulate appearance, margin at first incurved, even; flesh relatively thick, thinner on the margin, concolor. Gills adnate, rather narrow, of equal width, subdistant, waxy, "light orange-yellow." Stem 1-2.5 cm. long, 1.5-2 mm. thick, "light orange-yellow" (R), equal, glabrous, hollow, toughish, concolorous within, apex naked but attached at base by delicate radiating, pure white hairs; cortina none. Spores elliptical, smooth, hyaline,  $8-9 \times 4-4.5$  (5) $\mu$ ; basidia  $48-50 \times 7-8\mu$  cystidia none; gill-trama of interwoven hyphae; trama of pileus floccose, homogeneous, composed of concolorous hyphae; sterile cells inconspicuous.

"On a very decayed log under Douglas fir. Subcespitose. Mt. Hood, Oregon, October 16. Collected by L. E. Wehmeyer.

"This species departs in such minor particulars from the European form which goes under the name of *H. turundus* var. *mollis* that it seems clearly to be the same. I have here raised the variety to specific rank on microscopical grounds. The whole plant has a waxy lustre. No cortina was visible even in the youngest specimen. The decoration of the cap gives a white sheen when reflecting the light. It belongs in the subgenus *Camarophyllus*."

We have quoted Kauffman's (7) account. His specimens, unfortunately, were badly eaten by larvae before they were deposited in the herbarium, and not enough remain to make possible a study of the microscopic characters. It is quite obvious from Kauffman's account, however, that the species should be placed in the section *Pseudo-Camarophyllus*.

29. *HYGROPHORUS FIMBRIATOPHYLLUS* Kauff.

"Pileus 2-3 cm. broad, at first oval-hemispherical then broadly convex, obtuse, uniformly 'apricot-yellow' (R), fibrillose-floccose or broken into soft and small scales, margin even, at first incurved and silky from the cortina; flesh moist, concolor, 2 mm. thick near the stem, narrowed to the



margin of the pileus. Gills broadly adnate or at length spuriously subdecurrent, rather narrow, 2-4 mm., 'apricot-yellow,' waxy, edge concolorous and fimbriate. Stem 4-7 cm. long, tapering upwards, 2-3.5 mm. thick at the apex, 3-6 mm. at base, concolor, even, flexuous, at first silky-fibrillose, glabrescent. Odor and taste none, Spores subglobose to broadly elliptical, smooth, hyaline  $7-8 (9) \times 6-7\mu$ ; cystidia none; sterile cells on the edge of the gills prominent, cylindrical, obtuse,  $100-120 \times 4-5\mu$ , hyaline; gill-trama interwoven.

"On very rotten wood in conifer forest. Mt. Hood, Oregon. October 13. Collected by L. E. Wehmeyer.

"The pileus although fleshy is thin and somewhat pliant, but the waxy gills preclude the genus *Clitocybe*. The young plant is surrounded by the continuation of the pileus covering, thus indicating a universal veil. *H. intermedium* Pass-Ricken has a similar covering. Our plant belongs to the subgenus *Camarophyllus*."

We have quoted the original account. The type specimens were badly eaten by larvae before being deposited in the University Herbarium. Consequently we have been unable to confirm Kauffman's observations. We have not seen fresh material. The long cheilocystidia (sterile cells of Kauffman) at once distinguish the fungus from *Omphalia luteicolor* Murrill. Both apparently have somewhat similar colors.

### 30. *HYGROPHORUS CAESPITOSUS* Murrill.

Pileus 1-4.5 cm. broad, convex or the disc flattened, very soon becoming broadly or deeply depressed over the disc and with a spreading or turned up margin, moist but not viscid, margin even or wavy, moist but soon dry, not viscid, ground color usually "cream buff" to "honey yellow" (pale dull yellow), sometimes bright yellow, covered with small scales over all, scales somewhat recurved and "old gold" to darker brownish, the tips often blackish; flesh fairly thick, yellowish to bright yellow, odor and taste not distinctive or slightly of raw Irish potato; lamellae broadly adnate-decurrent or developing a long tooth, at times slightly sinuate-decurrent, broad, occasionally forked, white becoming yellowish, thick; stipe 2-4 cm. long, 3-7 (10) mm. thick, tapering slightly downward, glabrous, spongy, becoming hollow, often flexuous, moist or dry, concolorous with the pileus or a more sordid olivaceous yellow-brown; spores  $6.5-8 \times 5-6\mu$ , smooth, ellipsoid, not amyloid; basidia (35)  $40-58 \times (6.5) 7-9\mu$ , four-spored, the sterigmata 8-10 $\mu$  long; cheilocystidia and pleurocystidia none; gill-trama of subparallel to interwoven hyphae, the cells (8-12) 15-19 (28) $\mu$  in dia., yellowish in iodine; pileus-trama homogeneous beneath a turf-like covering of upright to appressed hyphae the free ends of which bear a slightly enlarged ovoid to ellipsoid cell, all parts golden yellow in iodine.

Cespitose or in groups of two or three individuals, Great Smoky Mts. National Park, Tenn., August or early September. Murrill reports it from New York and North Carolina.

Some of the specimens of the type are characterized by relatively long slender stipes in the dried condition. Murrill's dimensions of the fresh material, however, were 4-5 cm.  $\times$  3-5 mm. and thus fairly thick in relation to the length. In most of our collections the stipes were shorter, giving the fruiting bodies a squatty appearance. However, this is hardly a distinctive character. We have not found it fruiting in abundance, but believe that it is a more robust species than either Murrill's or our own specimens indicate. It is closely related to *H. Cantharellus* both by the nature of the hyphae covering the pileus and by its somewhat interwoven gill-trama. The colors clearly distinguish them, however. *H. squamulifer* Boud. appears to be closely related.

### 31. *Hygrophorus Cokeri* nom. nov.

(=*Hygrophorus gomphidioides* Coker, Journ. Elisha Mitchell Sci. Soc. 45: 168. 1929. Not *H. gomphidioides* P. Henn. 1908.)

"Cap 1.5-2.8 cm. broad, center strongly depressed, the margin curved and drooping, surface slightly viscid, distinctly fibrous, the fibers separated and inherent to form interrupted radial grooves, the tips pinched up to form small, scattered punctate squamules. Color about cinnamon-rufous to tawny or darker when soaked in age. Flesh tender, but not brittle, concolorous but paler, about 1.5 mm. thick near stem; odor none, taste distinctly and persistently bitter-astringent.

"Gills rather close, sub-decurrent, 2-3 mm. broad, thick, waxy, veined, a deep rich chestnut or mahogany brown, slightly glaucous from the spores, margins blunt and more or less uneven.

"Stem 1.5-3 cm. long, 3-6 mm. thick, smooth all over, usually flattened and channelled, crooked, subequal or tapering downward, about color of cap, the base usually constricted and slightly inserted; very hollow; flesh fibrous, easily splitting.

"Spores (print) white, oval or short-elliptic, smooth,  $3.8-5 \times 5.5-8\mu$ .

"The plant in form and color looks much like a small *Gomphidius*.

"It seems to fall in the *miniatus-cantharellus* group, but it is not very close to any of these. It is a very peculiar and well marked species, sharply distinguished by the conspicuously radiating fibrous lines on the cap, ending in delicate squamules, strongly depressed *Gomphidius*-like shape of the cap and the distinctive colors. The spores are smaller than others of the group.

"4248. Mixed woods, damp rocky, sandy soil near Meeting of the Waters, April 15, 1920."

Since we have not seen specimens, we have quoted the original account.

32. *HYGROPHORUS NITRATUS* Fr.

Pileus 2-5 cm. broad, convex to obtusely conic, becoming somewhat umbonate in age, surface moist or soon dry and at length fibrillose squamulose, very pale brownish at first, soon becoming grayish and finally dark grayish brown to nearly blackish, margin splitting readily, flesh thin, pale to dark brownish gray, very brittle, not changing color or becoming only slightly reddish when bruised, taste acidulous, odor strongly nitrous; lamellae subdistant broad, emarginate, whitish, darkening somewhat in age but not changing color readily when bruised, intervenose, edges even; stipe 5-8 cm. long, 3-6 mm. thick at apex, 6-10 mm. at the base, hollow, fragile, terete to compressed, glabrous, somewhat longitudinally striate, more or less concolorous with the pileus, pale brownish at first, dark grayish in age; spores subovoid to ellipsoid, smooth, hyaline, not amyloid,  $7-9 \times 4.5-6\mu$ ; basidia four-spored,  $32-40 \times 7-9\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of subparallel hyphae, yellowish in iodine; pileus-trama homogeneous, no gelatinous pellicle seen.

Singly to gregarious, on humus in mixed forests. Massachusetts and Tennessee.

Among Simon Davis's collections in the Univ. of Mich. Herbarium are several he identified as this species. Not much can be determined from his dried material, but from his notes it appears that he had correctly identified the fungus. It is closely related to *H. ovinus* and there may be enough intergradation to cause confusion. Hesler has one collection from Mt. LeConte which had the nitrous odor but stained reddish as in *H. ovinus*. Fruiting bodies of both must be very carefully dried to avoid blackening. Bresadola (1) has admitted a form to *H. nitratus* which also stains reddish. his specimens had two-spored basidia and spores  $8-11 \times 5-7\mu$ .

33. *HYGROPHORUS OVINUS* Fr. Plate 3.

Pileus (1) 3-7 cm. broad, convex to hemispheric, becoming broadly convex to somewhat expanded in age, the disc often remaining obtuse or somewhat flattened, brownish fuliginous at first or "clay color" on the disc to "pinkish buff" on the margin, paler and more grayish when faded, moist but soon dry and not viscid, when faded becoming minutely fibrillose-squamulose, somewhat rimose in age; flesh thick on the disc, thin toward the margin, pallid to whitish, soon reddish where cut or bruised, odor faint to fairly pronounced, pungent, taste slightly unpleasant; lamellae whitish readily staining pinkish when bruised and finally spotted blackish, nearly always blackening when dried, adnate at first, soon deeply emarginate, broad, moderately close to subdistant; stipe 2-8 cm. long, 4-10 (15) mm. thick, above, equal, sometimes the apex flared somewhat, hollow, terete or compressed and sometimes furrowed, readily becoming pinkish or vinaceous where handled or bruised and finally blackish, normally concolorous





Plate 3. *H. ovinus* Fr. X 1.

with the pileus or paler; spores  $7-9$  ( $10$ )  $\times$   $5-6$  ( $7$ )  $\mu$ , ellipsoid to subovoid, smooth, not amyloid; basidia four-spored,  $42-54 \times 6-7 \mu$ ; gill-trama parallel to subparallel, pale sordid vinaceous brown in iodine; pileus-trama homogeneous, no true gelatinous pellicle present, yellowish to sordid vinaceous brown in iodine.

Gregarious on soil under conifers or in mixed forests, Tennessee and California.

The dull colors, sharp odor, (but not nitrous), equal stipe, the color change exhibited by various parts, and the deeply emarginate gills distinguish our collections. The vinaceous reaction to iodine of the gill-trama and flesh of the pileus is best observed on specimens which have not blackened on drying. The reaction is sporadic and weak, most of the tissue remaining sordid yellowish brown.

## 2. *Laevi*

### 34. HYGROPHORUS COCCINEUS Fr. sensu Ricken. Plate 4.

Pileus 2-5 cm. broad, obtusely conic with an incurved margin when young, obtusely umbonate with a spreading margin in age, surface smooth, glabrous, moist or slightly sticky to the touch but lacking a well defined gelatinous pellicle, color evenly "nopal red" to "spectrum red" (a very brilliant cochineal red), fading somewhat but not becoming brilliant yellow (usually retaining considerable of the red color in drying), margin opaque or faintly striatulate when moist; flesh concolorous with the surface or paler reddish, waxy, soft, fragile, odor none, taste mild; lamellae broadly adnate to adnexed, often with a decurrent tooth, close to subdistant, broad, thickish, orange-red to yellowish orange, pallid yellowish when dried, edges even; stipe 3-7 cm. long, 3-8 mm. thick, glabrous, glistening, uneven, equal, hollow, fragile, moist but not viscid, concolorous with the pileus above or over all, soon becoming yellowish near the base, base sometimes whitish because of a thin coating of white mycelium; spores  $7-9$  ( $10$ )  $\times$   $4-5 \mu$  four-spored; cheilocystidia and pleurocystidia not differentiated; gill-trama of subparallel hyphae, yellowish in iodine; pileus-trama homogeneous, the pellicle consisting of a few radially arranged scarcely gelatinous hyphae.

Gregarious under redwoods in California. Specimens from Tennessee and Pennsylvania have also been studied.

Material collected near Lyon, France and identified as *H. coccineus* by Jossierand was communicated to Smith. It is the same as the material described above from California. Ricken's description applies remarkably well to all of these specimens and so we have used the name in the sense that he used it. Ricken emphasized that the cap was more moist than viscid. Fries, however, described the pilei of both *H. coccineus* and *H. puniceus* as viscid. Hence there appears to be a possibility that the *H. coccineus*

Plate 4. *H. coccineus* Fr. X1.



of Ricken and that of Fries are different. The specimens from California failed to show a distinct gelatinous pellicle either fresh or when revived, and no such layer was found on those from Jossierand. Specimens of *H. puniceus* sectioned and compared under the microscope showed a very well developed pellicle even on the oldest fruiting bodies. In spite of its lack of a pellicle, *H. coccineus* may feel slightly viscid when moist, and this may account for the statements to that effect in the literature. The color of the base of the stipe is very likely to lead one into trouble if he attempts to put much emphasis upon it. In *H. puniceus* according to our experience, it may be either whitish or yellow, most often white. In *H. coccineus* it is usually orange, but may appear white because of a thin coating of white mycelium which develops under moist conditions. Neither is there any appreciable difference in spore size. The specimens of *H. coccineus* from France had spores  $7-10 \times 4-5\mu$ . Ricken gives them as  $7-9 \times 5\mu$ , and in the California collection they were  $7-9 \times 5\mu$ . In *H. puniceus* they measure  $8-10 \times 5-6\mu$ . Kauffman gave them as  $9-12 \times 4-5\mu$  for *H. puniceus* and  $7-9 \times 5-6\mu$  for *H. coccineus*. These differences do not appear significant, and in addition it is possible that the larger spores in some of Kauffman's material came from two-spored basidia. We believe that his descriptions (6) p. 196-7 both apply to *H. puniceus*. Murrill (12) described *H. coccineus* as viscid and illustrated it as having practically the same color as *H. puniceus*. Hence his report and the distribution given in the North American Flora are also questioned. According to our experience, *H. puniceus* is a very common and variable species in North America whereas *H. coccineus* is very rare.

### 35. HYGROPHORUS MARGINATUS Peck. Plate 5.

Pileus 1-5 cm. broad, obtusely conic to gibbous at times, becoming irregularly convex or campanulate, sometimes becoming plane or with a low obtuse umbo, surface at first glabrous and moist, lubricous or somewhat viscid to the touch at times, in age occasionally lacerate-squamulose or rimose, hygrophanous, "zinc orange" to "orange" or with a tinge of olive when moist, fading to pale yellowish or nearly white, margin faintly striatulate at times; flesh thin, waxy, fragile, concolorous with the surface, odor and taste mild; lamellae arcuate-adnate but soon adnexed, sometimes emarginate, seceding somewhat in age, broad and ventricose, subdistant "Mikado orange" to "orange chrome" (deep brilliant yellow-orange), color usually persisting at least on the edges, intervenose, edges even; stipe (2) 3-8 cm. long, 3-6 mm. thick, equal or slightly ventricose, curved or flexuous, hollow, dry, terete or compressed, fragile, glabrous and moist, soon dry (not viscid), "warm buff" to "pale orange-yellow" (orange to yellow, paler in age); spores  $7-9 \times 4-6\mu$ , ellipsoid, smooth, not amyloid; basidia  $33-38 \times 8-9\mu$ , four-spored; cheilocystidia and pleurocystidia not differen-

tiated; gill-trama subparallel to interwoven, cells  $10-100 \times 10-20\mu$ , yellowish in iodine; pileus-trama homogeneous, pellicle thin, of radially arranged non-gelatinous cells, all parts yellowish to yellowish brown in iodine.

Singly to gregarious, moist woods and swamps, summer and fall, occasional to rare. Material has been examined from Nova Scotia and Ontario, Canada; New York, Massachusetts, Pennsylvania, Maryland, North Carolina, Tennessee, Kentucky, Michigan and Idaho in the United States. The species has been found in Europe also, see Kühner (9).

This is a very distinctive fungus readily characterized by the manner in which the gills hold their orange-yellow color after the other parts have faded or after the fruiting bodies have been dried. Our observations verify Kauffman's statement that the species is not viscid. The apparent viscid-ity occasionally noted is not caused by a gelatinous pellicle, but is rather the slight tackiness one frequently gets from contact with a moist surface. In many respects the species is related to *H. amoenus*, but differs in color, stature and in the absence of cystidia on the gills.

36. *Hygrophorus marginatus* var. *olivaceus* var. nov.

Pileus 1.5-3.5 cm. latus, acute conicus, glaber, udus, striatus, olivaceus vel olivaceibrunneus demum sordide aurantiacus; lamellae laete aurantiacae; stipes 3-5 cm. longus, 2-4 mm. crassus aequalis, demum cavus, glaber, viridis demum viridiluteus; sporae  $6.5-8 \times 4-5\mu$ .

Pileus 2.5-3.5 cm. broad, sharply conic, becoming sharply conic-campulate and finally nearly plane except for a sharp conic umbo, surface glabrous and moist but not viscid, margin translucent striate, color "olive brown" to "deep olive" over central portion or over all when real young, soon pale dull orange near the margin, in age the olive fading and the orange more widespread (never brilliant orange, however); flesh thin and fragile,  $\pm$  dull olive gray, odor and taste mild; lamellae ascending adnate, toothed, broad (5 mm.  $\pm$ ) close to subdistant (2 tiers of short individuals, 20-30 reach the stipe), evenly "ochraceous orange" and scarcely fading; stipe 3-5 cm. long, 2-4 mm. thick, equal, soon hollow, very fragile, glabrous, "grape green" becoming pallid greenish yellow; spores  $6.5-8 \times 4-5\mu$ , subellipsoid, not amyloid; basidia four-spored; cystidia none seen on sides or edges of gills; gill trama of interwoven, large inflated cells; pileus trama homogeneous, no gelatinous pellicle present.

Singly on very rotten wood of conifers, Noisy Creek, Baker Lake, Washington, September 5, 1941 (26633-S) type and at Marble Creek, Mt. Baker National Forest, September 6 (16709-S).

The prominent green color of the stipe and more pronounced olive color of the cap distinguish the variety from the species. The habitat may also be distinctive, but here more information is needed.

37. *HYGROPHORUS PARVULUS* Peck. Plate 15, b.

Pileus 1-4 cm. broad, obtuse to convex, in age broadly convex, sometimes with a depressed disc, surface glabrous and moist, at times subviscid, hygrophanous, evenly "apricot yellow" to "wax yellow," translucent striate and often translucent over the disc, opaque and a paler yellow when



Plate 5. *H. marginatus* Peck,  $\times 1$ .

faded, sometimes "orange" to "cadmium yellow" moist (bright orange yellow) and fading to "baryta-yellow" (pale yellow); flesh very brittle and waxy, thin, concolorous with the surface, odor and taste mild, no color change noted; lamellae subdistant (15-22 reach the stipe), 1-2 tiers of short individuals, broad (3.5 mm.), decurrent, intervenose, whitish or pale yellowish, edges even; stipe 2-4 cm. long, 2-4 mm. thick, terete or compressed, narrowed at the base or equal, hollow, very fragile, glabrous and moist, color evenly wax-yellow over all at first but the base frequently be-



coming tinged "Grenadine" or dull rufous (bright to dull red); spores  $5-7 \times 3-5\mu$  ellipsoid, hyaline, smooth, not amyloid; basidia four-spored,  $26-32 \times 6-7\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of interwoven cells, the cells  $10-20 \times 10-30\mu$ ; pileus-trama homogeneous, pellicle very poorly organized, the hyphae slightly gelatinous.

Cespitose to gregarious on humus under maple and oak, Milford, Mich. August 30, 1940, (15216-S). It has also been found in California. The description is from the cited collection.

38. *Hygrophorus mycenoides* sp. nov.

Pileus 6-12 mm. latus, convexus vel subconicus, demum subplanus, udus, glaber, striatus, aurantiacus vel aurantiaco-luteus, demum subalbidus; lamellae subdistantes, angustae, demum sublatae, adnatae, luteae demum albidae; stipes 2.5-4 cm. longus, 1-1.5 mm. crassus, aequalis, glaber, udus, subflavus; sporae  $6-7 \times 3\mu$ .

Pileus 6-12 mm. broad, convex or conic at first, the margin incurved, becoming convex to plane and with a slight umbo, sometimes the disc depressed slightly and the margin spreading, surface moist and lubricous (not truly viscid), striate to the disc at first, when fresh "deep chrome" to "light orange-yellow" over the center, the margin "mustard-yellow" to "naples-yellow" (orange-yellow around the disc, pale yellow toward the margin), finally fading to almost pure white, the yellow color occasionally persistent in various places; flesh thin, waxy, fragile, bright yellow fading to white, odor and taste not distinctive; lamellae subdistant (15-18 reach the stipe, 2 tiers of shorter individuals), sometimes appearing close when the short gills are well developed, narrow or at late maturity rather broad, broadly adnate to subdecurrent, bright yellow at first, the faces fading to white or pale yellow before the edges and hence the gills frequently appearing marginate, whitish over all in age; stipe 2.5-4 cm. long, 1-1.5 mm. thick, equal, slender, tubular, pale wax-yellow or concolorous with the pileus, glabrous, not viscid, attached to humus by radiating yellow hairs, in age fading to whitish but frequently remaining more brightly colored than the pileus; spores  $6-7 \times 3\mu$ , narrowly ellipsoid, hyaline, yellowish in iodine; basidia four-spored,  $20-30 \times 5-6\mu$ ; cheilocystidia abundant, subcylindric, the apices obtuse, thin-walled,  $28-33 \times 7-9\mu$ , with yellow contents at first, hyaline in age; pleurocystidia none; gill-trama of subparallel to interwoven hyphae, the cells  $20\mu$  wide and  $20-60\mu$  long, with pale yellow contents at first; pileus-trama homogeneous, no well differentiated pellicle present.

Scattered on humus in mixed forest, Cades Cove, Tenn. Great Smoky Mts. National Park, August 10, 1938, A. H. Smith 9988—type.

In all respects except its basidia this species appeared to be a true Hy-

grophorus, and in fact, is similar to *H. ceraceus* or *H. parvulus* in many respects. It is more *Mycena*-like than either, however, hence the specific name. It is also close to the very poorly known *H. aurantiaco-luteus* B. & C. but is distinct form that species as described by its broadly adnate rather than long-decurrent gills. Both apparently have brilliant orange colors and slender stature. Our specimens showed no resemblance to *Omphalia fibula* in general appearance, and it is largely on this basis that we have considered them to represent a different species. *H. subceraceus* Murr. also appears to be closely related, but is described as having a viscid pileus. *H. Wynniae* B. & Br. is close but has much broader spores and narrow decurrent lamellae.

39. *HYGROPHORUS AURANTIUS* Murrill.

"Pileus obconic, small, solitary, 1.5 cm. broad; surface smooth or slightly striate, glabrous, dry or moist, aurantiaceous, lamellae adnate, rather broad and distant, subconcolorous; spores globose, smooth, hyaline, 3-5 $\mu$ ; stipe slightly tapering downward, glabrous, aurantiaceous, pruinose at the apex, 2.5 cm. long, about 2 mm. thick."

The type was collected in Jamaica. We were unable to locate it and can add no further information about the species. The brilliant color and small spores form a distinctive combination of characters. The description is quoted from the original.

40. *HYGROPHORUS SUBCAESPITOSUS* Murrill.

"Pileus convex to plane or depressed, subcaespitose, 2-3 cm. broad; surface smooth, glabrous, ruber when young, miniatous when older; lamellae white to stramineous, adnate or slightly decurrent, broad, inserted; spores oblong-ellipsoid, smooth, hyaline, 8-9 $\times$ 5 $\mu$ ; stipe thick, cylindric to slightly flattened, smooth, glabrous, luteous or paler yellowish, about 3 cm. long, 5 mm. or more thick."

The type was collected in Jamaica. We have not been able to locate it and can offer no information other than that in the original description which we have quoted.

41. *HYGROPHORUS EARLEI* Murrill.

"Pileus convex, solitary, 3 cm. broad; surface glabrous, silky shining, not striate, pale reddish yellow; context yellow, mild; lamellae slightly adnexed crowded, broad, ventricose, cremeous, spores globose, smooth, hyaline 7 $\mu$ ; stipe somewhat flattened, equal, hollow, glabrous, shining, pale-yellow, 5-6 cm. long, 4-6 mm. thick."

The type was collected in Cuba. We have not been able to locate it, and have quoted the original description.

42. *HYGROPHORUS ROSEUS* Murrill.

"Pileus convex with an umbilicate center, resembling *Omphalia* in shape, solitary, 1 cm. broad, 5 mm. high; surface smooth, glabrous, not viscid, roseous to incarnate, margin entire or rarely lobed, decurved; context very thin, allowing the lamellae to show through on the upper side; lamellae decurrent, arcuate, white, stained with red; spores ovoid, smooth, hyaline,  $10-13 \times 7-9\mu$ ; stipe smooth, cylindric, paler than the pileus below, deep red at the apex, where it is much enlarged, 1.5 cm. long, 1 mm. thick below."

The type was collected in Jamaica. It consists of a small rose colored specimen somewhat resembling *H. miniatus* but much more delicate. We did not section it to verify the microscopic characters.

43. *HYGROPHORUS BELLUS* Massee.

"Pileus fleshy, convex-plane, slightly depressed at the center, 4-5 cm. broad; surface scarlet to expallent, smooth, glabrous: lamellae decurrent, distant, thick, interveined, yellow tinged with orange: spores ellipsoid, hyaline,  $18 \times 10\mu$ : stipe equal or enlarged at the apex, glabrous, hollow, yellowish with scarlet striae, 5 cm. long, 8 mm. thick."

The type was collected in the Nariaqua Valley, St. Vincent. We have quoted Murrill's account in the North American Flora. We have not seen material of this species, but its colors and large spores should be distinctive.

44. *HYGROPHORUS MEPHITICUS* Peck.

"Pileus thin, convex, becoming plane or nearly so, glabrous, hygrophanous, yellowish-brown and striatulate on the margin when moist, ochraceous when dry, sometimes tinged with green, flesh whitish, sometimes tinged with yellow, odor mephitic; lamellae broad, thick, unequal, distant, sinuate, adnexed, sometimes connected by veins, often wavy, grayish-violaceous or grayish-purple; stipe equal or tapering at the base, curved or flexuous, brittle, hollow, colored like or a little paler than the pileus, often with a whitish mycelioid tomentum at the base; spores white, elliptic,  $8-12\mu$  long,  $6-7\mu$  broad.

"Pileus 2-4 cm. broad; stem 3-5 cm. long, 2-5 mm. thick.

"Among sphagnum in swamps. Stow, Massachusetts. August, 1905. S. Davis. This peculiar and well-marked species is easily recognized by its unusual colors, odor and habitat. The odor persists several days after the plants have been collected; its similarity to that of a skunk has suggested its specific name."

We have not seen the type, but from Peck's description there seems to be little if any reason to place the species in synonymy with *H. auratocephalus* as was done by Murrill. The violaceous gills should at once distinguish it. By virtue of its bright colors and adnexed gills we tentatively



arrange it here although it is keyed out in *Camarophyllus* as well. The violaceous gills may indicate a relationship to certain species in that subgenus.

45. *HYGROPHORUS SPHAEROSPORUS* Peck.

"Pileus fleshy and thick in the center, subobconic, convex, obtuse or slightly umbonate, whitish, inclining to reddish-brown, the margin incurved, flesh firm, white; lamellae rather broad, subdistant, adnate or slightly decurrent, white; stems tufted, flexuous, solid, glabrous, often slightly thickened at the base, colored like the pileus; spores globose, .00024 to .0003 in. broad.

"Pileus 6-12 lines broad; stem 1 to 2 in. long, 2-3 lines thick.

"Iowa. October. Communicated by C. McIlvaine.

"The fresh plant is said to have no decided odor, but when partly dried it emits a slight but rather unpleasant odor. It belongs apparently to the section *Camarophyllus*, and is related to *Hygrophorus Peckii*."

The above is quoted from Peck's original account. We have examined the type. When sections of it are mounted in KOH the pellicle gelatinizes somewhat, but not as much as in *H. Peckii* (*H. laetus*). The gill-trama is of subparallel to interwoven hyphae. The cells are 20-80 $\mu$  long and 7-14 $\mu$  in dia. The trama is yellowish in iodine. The basidia measure 26-32  $\times$  7-8 $\mu$  and are four-spored. The spores are spherical, smooth, hyaline and not amyloid. They measure 5-7.5 $\mu$  in dia. Although the gills were described as subdistant, those on the type specimens appear to be rather crowded; 30-36 reach the stipe. The dried fruiting bodies lack the clean appearance of most *Hygrophori*, and on the basis of a comparison of herbarium specimens there is no resemblance between *H. Peckii* and *H. sphaerosporus*. We believe that the pileus in *H. sphaerosporus* will be found to be at least somewhat lubricous when moist because of the pellicle. The dried pilei however are dull and unpolished.

46. *Hygrophorus deceptivus* sp. nov. Plate 2,a.

Pileus 12-40 mm. latus, convexus, demum subplanus, canescens, sordide ochraceo-brunneus, subhygrophanus; lamellae late adnatae vel arcuatae, latae (6 mm.  $\pm$ ), confertae vel subdistantes; stipes 5-10 cm. longus, 4-8 mm. crassus, deorsum 3 mm., fragilis, cavus, sordide ochraceo-brunneus; sporae 4-5  $\times$  3-4 $\mu$ .

Pileus 12-40 mm. broad, convex, becoming expanded and the margin slightly upturned and splitting, canescent, hygrophanous, not at all viscid, "tawny-olive" to "Sayal brown" or "cinnamon-brown" when moist (sordid yellowish brown to dark cinnamon-brown), disc usually darker, "pinkish buff" (pale buff) when faded, margin thin, even, appearing appressed fibrillose when faded; flesh thick on the disc, thin on the margin, odor none or earthy, taste mild or slightly acidulous; lamellae broadly adnate to

arcuate and becoming slightly decurrent, broad and ventricose (up to 6 mm.), close to subdistant, (26–32 reach the stipe), pale buff-color or concolorous with the pileus, not darkening in age or when dried, edges even; stipe 5–10 cm. long, 4–8 mm. thick at the apex, 3 mm  $\pm$  at the base, hollow and fragile, concolorous with the pileus, glabrous or the apex canescent or pruinose, not viscid; spores ovoid to subglobose, 4–5  $\times$  3–4  $\mu$ , smooth, not amyloid (slightly yellowish brown in some); basidia short and slender, 26–34  $\times$  3–4  $\mu$ , four-spored, dark sordid yellowish brown in iodine; gill-trama of elongated cells in subparallel arrangement, 8–12  $\mu$  broad (not intricately interwoven), yellowish in iodine; pileus-trama homogeneous, pellicle not sharply differentiated, yellowish to brownish in iodine.

On humus in the Great Smoky Mts. National Park, both in North Carolina and Tennessee, The type was collected by L. R. Hesler, 10247, July 30, 1939.

This species superficially closely resembles *H. hymenocephalus* but lacks the palisade of clavate cells over the surface of the pileus. It also differs in its closer gills which do not become dark gray or drab in age. Its minute spores and lack of odor separate it from *H. ovinus* and *H. nitratus*. In some respects it is very similar to *H. sphaerosporus* but there is a distinct difference between the spores and very likely between the colors of fresh fruiting bodies. *H. Schulzeri* Bres. sensu Jossierand (5) belongs here. We are reserving the name *H. Schulzeri* for a Camarophyllus on the order of *H. microsporus* or *H. albipes*. The subgeneric position of Bresadola's species cannot be settled without an examination of the type specimens.

#### 47. *Hygrophorus subaustralis* sp. nov.

Pileus 1–3 cm. latus, subumbonatus, siccus, subfibrillosus, candidus; lamellae adnexae, latae, confertae vel subdistantes, candidae; stipes 1–3 cm. longus, 2–3 mm. crassus, aequalis, farctus, candidus, fibrillosus; sporae 4–5  $\times$  3–4  $\mu$ ; cheilocystidia et pleurocystidia 46–60  $\times$  8–14  $\mu$ .

Pileus 1–3 cm. broad, convex to plane, with low conic umbo, margin incurved slightly at first, surface dry, under a lens appearing matted-fibrillose, shining white over all, opaque at all stages; flesh white, waxy, odor none, taste bitterish, no color change noted; lamellae adnexed, broad, close to subdistant, thin but distinctly waxy, pure white, edges even; stipe 1–3 cm. long, 2–3 mm. thick, equal, stuffed, becoming hollow, white within, surface dry and appressed cottony-fibrillose over all or the apex delicately pruinose, shining white over all; spores 4–5  $\times$  3–4  $\mu$ , subglobose, smooth, hyaline, not amyloid; basidia four-spored, 24–26  $\times$  5–6  $\mu$ ; cheilocystidia and pleurocystidia scattered to abundant, fusoid ventricose with obtuse apices, thin-walled, hyaline, 46–60  $\times$  8–14  $\mu$ ; gill-trama subparallel, of broad elongated hyphae (as in *H. miniatus*), hyaline; pileus-trama homogeneous, pellicle not differentiated.

Along the trail to Bryson Place, Martin's Gap, N. C., Great Smoky Mts. National Park. Sept. 2, 1938, A. H. Smith 10844—type.

This curious shining white species is very easily distinguished by its almost globose spores and thin-walled cystidia. The species is similar to *H. huronense* in having short basidia, a character which might influence some to exclude both from *Hygrophorus*. Particular attention was given to this character in the study of the fresh specimens in both cases, and in neither did it appear to be sufficient to outweigh the very obvious waxy consistency and *Hygrocybe*-like gill structure. The unpolished surface of the pileus and stipe of *H. subaustralis* suggests a *Tricholoma*. It is readily distinguished from *T. cystidiosum* by its spores, thin-walled cystidia and more waxy consistency.

48. *HYGROPHORUS ALBOUMBONATUS* Murrill.

"Pileus conic, with long cylindric umbo, solitary, 2.5 cm. broad, nearly 2 cm. high; surface smooth, glabrous, moist, white; lamellae broad, ventricose, thin, white; spores subglobose, smooth, hyaline,  $5-7\mu$ ; stipe curved, terete, equal, glabrous, moist, white, 5 cm. long, 2 mm. thick."

The type was collected in Jamaica. We have quoted the original description. Although we could not locate the type, we have placed the species in this subgenus because the conic species all appear to have more or less parallel gill-trama. The globose spores are peculiar for a fungus of this kind.

49. *HYGROPHORUS AMOENUS* (Lasch) Quél. Plate 10.

Pileus 2.5-6 cm. broad, sharply conic to cuspidate, becoming expanded but retaining a prominent conic umbo, margin faintly striatulate when moist, spreading or recurved and rimose or lobed in age, surface slightly viscid when moist, soon dry and appearing innately fibrillose under a lens, "terra cotta" to "vinaceous tawny" when moist (dull pinkish red or occasionally tinged with lavender), fading to "buff pink" or "shell pink" (very bright delicate pink), the disc sometimes whitish; flesh thin to moderately thick, pinkish, odor and taste not distinctive; lamellae ascending adnate and becoming adnexed, close to subdistant (50-55 reach the stipe), narrow but becoming somewhat ventricose (5-6 mm), sometimes intervenose, "hydrangea-pink" (pale bright pink), edges undulated and minutely fimbriate at times; stipe (2) 5.5-16 cm. long, 4-8 (10) mm. thick, strict, equal, hollow, very fragile, splitting readily, surface glabrous and lubricous but not viscid, often longitudinally striate or twisted-striate, terete or occasionally compressed, whitish tinged flesh-color, sometimes tinged with lavender when young; spores  $6.3-8(9) \times 4.5-5(6)\mu$ , broadly ellipsoid, not amyloid; basidia four-spored, rarely two-spored,  $36-52 \times 7-9\mu$ , sterigmata up to  $9\mu$  long; cheilocystidia and pleurocystidia similar and



scattered,  $50-86(110) \times 10-25\mu$ , clavate, cylindric or fusoid ventricose, projecting about  $20\mu$ , thin-walled, hyaline, simple or occasionally branched near the apex; gill-trama of parallel to somewhat interwoven hyphae, the cells  $11-18\mu$  broad, yellowish to very pale vinaceous in iodine (not truly amyloid); pileus-trama homogeneous beneath a very thin disorganized pellicle of subgelatinous hyphae, yellowish in iodine.

Scattered to gregarious, North Carolina, Tennessee and California. Summer and fall. Very rare in North America. We have found it more abundant in the Great Smoky Mts. National Park than anywhere else.

*H. calyptraeformis* is here considered a synonym of *H. amoenus*. This is one of our most beautiful and delicately colored Hygrophori. The stature is much like that of *Entoloma salmoneum* Pk. but of course the latter is at once distinguished by its angular spores. *H. amoenus* appears to be related to *H. cuspidatus*, *H. marginatus*, *H. Langii* etc. from which the characters given in the key readily separate it. The large cystidia are its most outstanding microscopic character. These have been found in all of the material examined and are usually abundant enough so that one needs to make only a few sections.

#### 50. *HYGROPHORUS IMMUTABILIS* Peck.

"Pileus thin, conic or convex, umbonate, often striate when dry, greenish brown or yellowish brown, not changing color in drying; lamellae subdistant, whitish or yellowish; stem slender, glabrous, hollow, yellow; spores elliptic, .0004-.0005 of an inch long, .00024-.00028 broad.

"Pileus 8-12 lines broad; stem 1-2 inches long, 1.5-2 lines thick.

"Dry sandy soil in bushy places. Essex county, August. Rare. Found but once."

The above is quoted from Peck's (14) account of the New York species. The type is well preserved and has a very distinctive appearance. The color of the pileus is dull dark brown and the gills pale cinnamon. Sections were made and the spores were found to be  $9-11 \times 5-7\mu$ , ellipsoid, smooth and not amyloid. The basidia are four-spored and  $30-36 \times 8-9\mu$ . Cheilocystidia and pleurocystidia are not present. The gill-trama is made up of parallel hyphae which are yellowish in iodine. No gelatinous hyphae were found on the surface of the pileus. The species appears to be very distinct, but it has not been our good fortune to see fresh specimens.

#### 51. *HYGROPHORUS SUBFLAVIDUS* Murrill.

"Pileus conic to subcampanulate, umbonate, gregarious, reaching 5 cm. broad and 3 cm. high; surface pale-flavous, dull-luteous in very young stages and on the umbo, moist, smooth, becoming striate in old or wet specimens; lamellae adnate with decurrent tooth, broad, ventricose, rather distant, pale-yellow; spores globose, smooth, hyaline,  $5\mu$ ; stipe cylindric, equal, pale-flavous, glabrous, 4-5 cm. long, 4-7 mm. thick."



Plate 6. *H. conicus* Fr.  $\times 1$ .

The type was collected in Jamaica. We have not been able to locate it, but have quoted the original description.

#### Section EU-HYGROCYBE

The members of this group are characterized primarily by their viscid pilei and dry to moist stipes. Two series are represented, those with sharply conic pilei and those with obtuse pilei. The species of subsection Conici are very closely related to those of the preceding subsection having conic pilei. Relationships are difficult to determine within such a homogeneous series of species as is found in this section.

1. *Conici*52. *HYGROPHORUS CONICUS* Fr. Plates 6 & 7.

Pileus (2) 3-7 (9) cm. broad, sharply to obtusely conic, sometimes convex with a conic umbo, not expanding, surface slightly viscid when moist (occasionally with a thin glutinous covering after heavy rain), soon dry, glabrous or somewhat virgate in age and sometimes becoming fibrillose-subscaly from the lacerated cuticle, margin frequently incised or lobed, sometimes rimose, color variable, usually reddish or scarlet-orange around and on the umbo and paler orange toward the margin, often with distinct olive tints and occasionally bright yellow until late maturity, gradually becoming olive-gray to black in aging, quickly becoming black when bruised or broken; flesh thin and very fragile, concolorous with the surface and blackening like it, odor and taste not distinctive; lamellae nearly free, close, broad, ventricose (1-2 cm. in large caps), nearly white at first, becoming grayish olivaceous, pale yellowish orange or olive yellow ("orange buff," "sulphur-yellow" "olive-ochre") black when bruised or in age, edges undulate to serrate or eroded; stipe (2) 6-11 (18) cm. long, 5-10 (15) mm. thick, equal, strict, hollow, moist to dry but not viscid, very fragile, splitting readily, glabrous or with appressed fibrils, often longitudinally striate and twisted, base whitish, remainder dark red, orange, yellow or sordid olive-yellow, becoming black in age or where bruised; spores (8) 9-12 (14)  $\times$  (5) 5.5-6.5 (7.5) $\mu$ , smooth, not amyloid, subellipsoid (often irregular in shape); basidia (30) 34-39  $\times$  (6) 9-11 $\mu$ , one-, two-, three- or four-spored; cheilocystidia and pleurocystidia none; gill-trama parallel, with large lactifers intermingled, yellowish to hyaline in iodine; pileus-trama homogeneous, pellicle formed by a thin poorly organized layer of gelatinous hyphae.

Singly or gregarious, throughout North America, summer and fall. One of our commonest mushrooms; common in wet places and upland woods alike.

The viscosity of the pileus is caused by a very thin layer of gelatinous hyphae. This layer may be washed away by heavy rains by the time the specimens reach maturity and the pilei then seem to be merely moist or slightly lubricous. In very dry weather, if there is not enough moisture to cause the hyphae of the pellicle to gelatinize appreciably, the pileus may seem lubricous or dry also. Thus in very wet weather or very dry weather, one may find it difficult to decide whether or not the pileus is viscid.

In North America we have certain forms which have four-spored basidia regularly and their spores measure 9-12 (14)  $\times$  5-7 $\mu$ . In other four-spored forms the spores measure 7-10  $\times$  4-6 $\mu$ . In addition we have many aberrant forms. Some of these are constantly two-spored with spores 9-12  $\times$  5-6 $\mu$ , and some occur with one- two- or three-spored basidia all on the same pi-



leus. In the latter both the size and shape of the spores is extremely variable. Spores  $15 \times 8\mu$  have been seen on some of these.

One of the commonest forms encountered is two-spored, and has a pileus 1.5-3 cm. high and a short (3-5 cm.) narrow stipe. During the season of



Plate 7. *H. conicus* Fr.  $\times 1$ .

1940 in the vicinity of Ann Arbor, the large four-spored form was very common. The first of these is the one Lange (11) considers typical *H. conicus* whereas the second he has named *H. pseudoconicus*. *H. nigrescens*, which is said to be white when young, we have not collected. Since the two-spored character has been shown to be of no value as a specific dis-

tingtion, and since the color differences Lange mentioned do not hold true for American material, we classify all our collections under the older name.

53. *HYGROPHORUS RAVENELII* B. & C. sensu Coker.

"Cap 4-6 cm., campanulate and strongly pointed, umbonate, grabrous, glutinous, striatulate when moist, color wax to cadmium yellow on margin, the center deepening through orange to nearly scarlet on the umbo or the more intense central color may be only orange or pale orange (the general effect of the cap color is yellow tinged with red). Flesh brittle and fragile and very thin, about 2 mm. thick near the center, yellow or under the cuticle orange: tasteless and odorless.

"Gills rather close, then at maturity not close (never distant), thin, broad, up to 8-9 mm., rounded at the stem and usually only narrowly adnexed, the margins uneven; color a clear wax yellow.

"Stem long, 6-14.5 cm., 6-9 mm. thick, nearly equal, glabrous, shining, slightly viscid (not glutinous), color of gills or a little darker above, shading to pure white on the lower third; when bruised turning smoky brown, then almost black after hours. Structure very fibrous, lightly stuffed, then hollow, the fibers easily splitting.

"Spores (of no. 3590, print) smooth, elliptic, extremely variable in size in the same plant,  $5-8 \times 8.5-14\mu$ . Basidia clavate, 2-spored,  $7-9.3 \times 27-35\mu$ , counting the sterigmata which are about  $5\mu$  long.

"On exposure to air in the laboratory, the colors of all parts become more intense, the cap becomes more red, the gills and stem a deeper yellow."

We have examined coll. 3780 (Herb. Univ. of N. Carolina), collected by H. R. Totten, Nov. 20, 1919. The basidia of the pileus examined were mostly four-spored. The spores measured  $10-14 \times 6-8\mu$ , were smooth and not amyloid. Basidia up to  $40\mu$  long were found and the gill-trama is of parallel hyphae. Only a few threads of gelatinous hyphae were found as a pellicle, the majority had apparently been washed off. Clamp connections were abundant on the basidia and the binding hyphae of the stipe.

Murrill placed *H. Ravenelii* in the excluded list of species of *Camorophyllus* with the following comments: "The pileus is convex, cespitose, 4-6 cm. broad, orange-colored; lamellae emarginate, paler; stipe yellow, 10-12 cm. long. The stipe is usually long and thick and whitish at the base, as in *Camorophyllus auratocephalus*. A sketch of the single type specimen at Kew and a mount of the spores, which are oblong-ellipsoid, smooth, hyaline,  $7-8 \times 5\mu$ , were prepared for me by Miss Wakefield."

The following is the English description given in the original account of the species: "Caespitose. Pileus  $1\frac{1}{2}-2\frac{1}{2}$  inches across, convex, smooth, moist, orange-red; flesh very thin, yellow. Stem 4-5 inches high,  $\frac{1}{4}$  inch thick, fistulose, brittle, yellow, whitish and attenuated below. Gills paler than the pileus, ventricose, deeply emarginate but attached. Spores white."

From Murrill's comments and the data contributed by Miss Wakefield in addition to the information in the original account, it is apparent that Coker's (2) specimens differ from *H. Ravenclii* in their conic viscid pilei, large spores and in the changing stipe. We have not seen fresh material of either species and hence hesitate to do more than bring the available data together. The specimen we examined did not appear to be *H. Langii*, but



Plate 8. *H. cuspidatus* Peck,  $\times 1$ .

the latter is obviously closely related. The most significant difference appears to be in the slight color change exhibited by the stipe of the former. Coker points out that this change could be easily overlooked.

54. *HYGROPHORUS CUSPIDATUS* Peck. Plate 8.

Pileus 2-7 cm. broad, cuspidate or sharply conic, expanding somewhat but retaining a sharp prominent conic umbo, margin often recurved and often lobed or split, surface smooth and glutinous, merely viscid or appearing as if varnished when dried out somewhat, evenly "scarlet red" or a deep



blood red over all, finally fading to "orange chrome" or paler (brilliant orange), margin striatulate; flesh yellow beneath the thick red cuticle, thin and fragile, waxy, odor and taste not distinctive, not changing color when bruised and not blackening in age; lamellae close to crowded but becoming subdistant as the pileus expands, free or just reaching the stipe, at first narrow but becoming up to 1 cm. broad, "pale orange-yellow" (bright yellow), edges usually eroded; stipe 5-9 (18) cm. long, 5-10 (12) mm. thick, equal or slightly enlarged below, stuffed but becoming hollow, very fragile, surface moist but not viscid, smooth but in age becoming longitudinally striate and sometimes lacerated slightly, "pinard yellow" over the mid-portion, apex "deep chrome" (brilliant yellow and deeper in color than the lower portion), base whitish; spores 9-12 (14)  $\times$  5-7 $\mu$ , ellipsoid, yellow in iodine; basidia 28-36 (42)  $\times$  9-10 $\mu$  clavate, two- or four-spored; cheilocystidia and pleurocystidia none differentiated or basidia-like but with the enlarged apex 10-15 $\mu$  broad; gill-trama of enlarged parallel hyphae; pileus-trama homogeneous beneath a gelatinous pellicle.

Gregarious on humus in hardwoods or mixed forests, summer and fall after periods of heavy rain. We have collected it in Michigan, Tennessee and Washington. Coker (2) has found it in North Carolina. It was originally described from Ottawa, Canada.

Specimens of this species do not blacken when bruised or dried, a character which at once distinguishes it from *H. conicus*. The size of the basidia varies in different collections, but all are the broad clavate type. Both two- and four-spored individuals can be found on a single pileus. Consequently we are inclined to allow considerable variation in spore size. The bright red color at once distinguishes *H. cuspidatus* from *H. Langii*.

*H. croceus* sensu Bresadola appears to be very similar to *H. cuspidatus*, but is apparently characterized by the less persistent reddish orange color of the pileus in contrast to the scarlet or blood-red color of the American species. However, *Agaricus croceus* Bull. was originally described as blackening, and has been referred to *H. conicus* as a synonym. Hence Bresadola's use of the name does not appear to be justified. *H. persistens* Britz. may be identical with Peck's species, but is described in Britzelmayr's revision as having a viscid stipe. Murrill's *H. californicus* is also distinct from *H. cuspidatus* in having a viscid stipe, and does not appear distinct from *H. persistens*.

##### 55. HYGROPHORUS AURATOCEPHALUS Ellis.

Pileus 3-5 cm. broad, at first obtusely conic, then campanulate and conspicuously umbonate, sometimes expanded and with a low obtuse umbo, surface glabrous and slightly viscid from a subseparable pellicle when moist, subhygrophanous and soon dry, margin even, young pilei appearing faintly innately silky, in age rimose or splitting radially along the elevated margin, colors bright yellow fading to pale yellow ("cadmium-yellow," "deep

chrome" or "yellow-ochre" when moist, paler when faded); flesh equally thin, fragile, yellow fading to white, taste slightly disagreeable, odor strong or slight, rather penetrating and mephitic; lamellae broadly adnate with a triangular decurrent tooth, very broad (up to 1 cm.), ventricose, subdistant to distant "capucine-yellow" to "cadmium-yellow" when fresh (not golden yellow), tapering gradually downward, 7 mm. thick at the apex, 2-3 mm. thick at the base, moist or slightly subviscid, "mustard yellow" (pale bright yellow) over all or whitish at the base, terete, strict, subfragile, hollow; spores  $7-9 \times (4) 4.5-6 \mu$ , ellipsoid to subovoid, smooth, not amyloid; basidia four-spored,  $45-50 \times 6-7 \mu$ , tapering evenly to the base; cheilocystidia and pleurocystidia none; gill-trama interwoven to subparallel, yellowish in iodine; pileus-trama homogeneous beneath a thin gelatinous pellicle, all parts yellowish in iodine.

Scattered in wet places along streams or on springy ground, usually under conifers, late summer and fall, New Jersey, Pennsylvania and Michigan.

No. 1911 of Ellis & Everhart's North American Fungi has been studied and its spores are as given above. Occasional large spores are found which may arise from two-spored basidia. They are irregular in shape and do measure up to  $10 \mu$  long. The species is very distinct from though closely related to *H. marginatus*. The difference in the color of their gills will readily distinguish them if the odor of *H. auratocephalus* happens to be very faint or lacking.

#### 56. *HYGROPHORUS LANGII* Kühner. Plate 9.

Pileus 2-6 cm. broad, obtusely to sharply conic when young, soon campanulate or the margin finally spreading, with a conic or prominent but obtuse umbo in age, surface glabrous, viscid or glutinous, margin striatulate to opaque and splitting easily, evenly "cadmium-yellow" over all (brilliant yellow), hardly fading; flesh soft, thin on the margin, thickish under the umbo, yellow, odor and taste not distinctive; lamellae ascending, free or narrowly adnexed, ventricose and moderately broad (2-4 mm.), close to subdistant, yellow, edge entire but becoming eroded at times; stipe 6-8 (12) cm. long, 3-6 (8) mm. thick, equal to subequal, terete or compressed, fibrillose to glabrous, sometimes twisted-striate, "cadmium-yellow" inside and out, paler at the base, subviscid to the touch at times but lacking a surface-covering of gelatinous hyphae, not blackening; spores  $9-12 \times 4.5-6 \mu$  or  $11-15 \times 6-7 \mu$ , not amyloid, ellipsoid; basidia two- or four-spored,  $28-36 \times 9-12 \mu$ , clavate; cheilocystidia and pleurocystidia none; gill-trama of parallel hyphae; pileus-trama homogeneous beneath a gelatinous pellicle.

Singly to scattered on humus under hardwoods or in mixed forests, Michigan and Tennessee.

Kauffman and Smith (8) reported this species under the name *H. Rick-*

*enii* Maire, a synonym of *H. Langii* Kühner. *H. Langii* Dodge is another synonym. Kauffman and Smith (8) described the stipe as viscid. This was an error. When wet the surface of the stipe may feel somewhat sticky but lacks a covering of gelatinous hyphae. When faded, specimens of *H. cuspidatus* are indistinguishable from specimens of *H. Langii*. Unless the red



Plate 9. *H. Langii* Kühner,  $\times 1$ .

color of the former is preserved in drying, herbarium specimens of the two are also indistinguishable. Singer (18) has referred *H. croceus* sensu Bres. and *H. Langii* Kühner to *H. persistens* Britz. as synonyms. Since we recognize *H. persistens* as having a viscid stipe, we do not accept Singer's synonymy.

We have one specimen from Tennessee which may represent an intermediate form between *H. auratocephalus* and *H. Langii*. It is identical with



the latter except for its spores which are  $7-9 \times 5-6\mu$ . It could be an odorless form of *H. auratocephalus* or a small spored *H. Langii*.

57. *Hygrophorus acutus* sp. nov.

Pileus 3-4.5 cm. latus acute conicus demum conico-umbonatus, glaber, subviscidus, subplumbeus vel umbrinus; lamellae adnatae, confertae, angustae, pallidae vel cinereae; stipes 7-9 cm. longus, 6-8 mm. crassus. solidus, aequalis, albidus, glaber vel sursum furfuraceus, sporae  $6-7 \times 4-5\mu$ .

Pileus 3-4.5 cm. broad, with a sharp conic umbo and a somewhat flaring margin, surface glabrous, subviscid to viscid, pellicle separable in shreds, color dull lead gray or putty-color over the umbo, pallid umbrinous toward the margin, short striate but not translucent; flesh grayish, thick under the umbo, thin elsewhere, waxy and brittle, odor and taste mild; lamellae close to subdistant, adnate to adnate-decurrent, seceding at times, narrow (4-5 mm. broad), intervenose, whitish to pale cinereous (just off color from white to pale ash-color), edges even, no color change on bruised portions; stipe 7-9 cm. long, 6-8 mm. thick, solid, equal, white over all both inside and out, glabrous or slightly scurfy above, unpolished, not changing color when bruised; spores  $6-7 \times 4-5\mu$ ; ellipsoid, smooth, hyaline, not amyloid; basidia four-spored,  $40-44 \times 6-8\mu$ ; cheilocystidia and pleurocystidia none; gill-trama of subparallel hyphae, the central portion of short fat hyphal cells quite distinctly interwoven; pileus-trama homogeneous beneath a thin but distinct gelatinous pellicle.

Singly under fir, South Fork of the McKenzie River, Ore. Oct. 20, 1937, A. H. Smith 7986-type. Also found under redwood, Orick, Calif. Dec. 4, 1937 (9395-S).

The most distinguishing features of this species are the stature, which resembles that of *H. amoenus*, the dark gray viscid pileus, white dry stipe and small spores. The gill-trama of *H. acutus* is more interwoven than that of most species in this series. *H. fornicatus* was collected near *H. acutus* on Dec. 4 and the two compared. The most important difference is in stature, but *H. acutus* is also much darker in color and its gills are sinuate or adnixed.

2. *Obtusi*

58. *Hygrophorus brevipes* sp. nov.

Pileus 2-2.5 cm. latus, obtusus, subcampanulatus vel planus, glaber, lubricus vel subviscidus, hygrophanus, albidus, nitens; lamellae confertae, angustae, subdecurrentes, albidae; stipes 1.5-2 cm. longus, 6-8 mm. crassus, aequalis, glaber, siccus, albidus; sporae  $9-12 \times 5-6\mu$ .

Pileus 2-2.5 cm broad, obtuse becoming broadly campanulate to plane with a low obtuse umbo, the margin sometimes flaring in age, glabrous, hygrophanous to subhygrophanous, lubricous to subviscid, pure white or



Plate 10. *H. amoenus* (Lasch) Quél. X1.

tinged cream-color on the disc, fading to a dead white and when dried white or very faintly cream-color and shining; flesh fragile, fairly thick, white, odor and taste not distinctive; lamellae close, thickish, narrow, adnate-decurrent with a pronounced tooth, white, unchanging; stipe 1.5-2 cm. long, 6-8 mm. thick, equal, solid, glabrous, dry, white; spores  $9-12 \times 5-6.5\mu$  ellipsoid, not amyloid; basidia four-spored,  $38-44 \times 8-9\mu$ ; cheilocystidia and pleurocystidia none; gill-trama of subparallel hyphae, the cells  $30-80 \times 9-15\mu$ , yellowish in iodine; pileus-trama homogeneous beneath a scarcely differentiated rather thick subgelatinous pellicle.

Gregarious on humus in oak woods, Ann Arbor, Mich. Oct. 13, 1936, A. H. Smith 6056-type.

Although *H. brevipes* has the stature of a small specimen of *H. pratensis* it shrinks more than specimens of that species when dried and the pilei have a shining appearance. The colors and large spores give it some resemblance to *H. virgineus* in which we were at first inclined to place it. *H. virgineus* is a typical Camarophyllus with interwoven trama, however, and has an unpolished appearance when dried. It is very difficult to compare a species like this with those known for Europe because the gill-trama of many of the more unusual European species has apparently not been critically studied. On the basis of stature alone *H. brevipes* could be referred either to *Limacium* or *Camarophyllus*, but one would not be likely to place it in *Hygrocybe*. *H. stenophyllus* Mont. is described as cespitose, but otherwise appears to be close to *H. brevipes*. However, it has not been recognized since it was described, and there is no information concerning its gill-trama. It could be either a *Limacium* or a *Camarophyllus*.

#### 59. *Hygrophorus huronensis* sp. nov. Plate 14.

Pileus 1-3 cm. latus, convexus, vel subplanus, glaber, viscidus hygrophanus, striatus, candidus demum albidus; lamellae subdistantes latae, adnexae, albidae; stipes 3-5 cm. longus, 3-5 mm. crassus, aequalis, glaber, udus (non viscidus), albidus; sporae  $7-9 \times 5-6\mu$ .

Pileus 1-3 cm. broad, convex, the margin incurved somewhat, the disc flattened but not appreciably depressed, becoming broadly convex to nearly plane in age, not umbonate, glabrous, viscid, hygrophanous, conspicuously translucent striate when moist, appearing glassy and shining watery white, sometimes with a watery-gray circle around the disc, (similar in color to the radial striae), opaque when faded and snow-white over all, at times the disc becoming irregularly cracked, flesh thin, firm, very waxy, watery-white, becoming snow-white, not very brittle, odor and taste mild, no color change noted in age or where bruised; lamellae subdistant (33-37 reach the stipe, 1-2 tiers of short individuals), broad (3-4.5 mm.), sharply adnexed, white, unchanging, thin but firm, edges even; stipe 3-5 cm. long, 3-5 mm. thick, equal or a bit enlarged above,



stuffed, becoming hollow, firm and waxy in consistency, the pith when present fibrillose, surface glabrous, translucent and appearing glassy when moist but not viscid, becoming opaque in age but color changing very slowly, snow-white in age, not staining when bruised; spores  $7-9 \times 5-6\mu$ , ellipsoid, hyaline, not amyloid; basidia  $28-34 \times 8-10\mu$ , clavate, not greatly elongated, four-spored; pleurocystidia and cheilocystidia not differentiated, gill-edge fertile and not gelatinous; gill-trama of parallel hyphae, sub-hymenium not gelatinous; pileus-trama homogeneous beneath a thick gelatinous pellicle.

Gregarious on grassy soil under brush along the Huron River, Ann Arbor, Mich. Sept. 15, 1940, A. H. Smith, 15376-type. Known only from the type locality.

The convex viscid pileus, dry stipe, adnexed gills and white color throughout amply characterize this species. It appears to be the counterpart of *H. flavescens* but is white instead of yellow. *H. purus*, another white species, differs in having a sharply conic pileus and a viscid stipe. Lactifers are present in the flesh of the pileus and occasionally in the gill-trama of *H. huronensis*, but are not as large as those of *H. flavescens*.

60. **Hygrophorus flavescens** (Kauff.) comb. nov. Plate 13.

(=*H. puniceus* var. *flavescens* Kauff. 8th Rept. Mich. Acad. Sci. 1906).

Pileus 2.5-6 (7) cm. broad, broadly convex with an incurved margin when young, becoming flattened or slightly and broadly depressed on the disc, the margin remaining somewhat decurved, glabrous, striatulate when moist, surface very viscid but soon dry and shining, "cadmium-orange" to "Mikado orange" (very brilliant full orange) or sometimes "mustard-yellow" from the beginning when moist, fading to "light orange-yellow" to "amber-yellow" (pale orange to pale yellow); flesh thin and waxy, yellowish, odor and taste not distinctive; lamellae broad, adnexed, close to subdistant, "mustard-yellow" to "pinard-yellow" (pale yellow); stipe 4-7 cm. long, 8-12 (16) mm. thick, equal or narrowed below, hollow, fragile, glabrous or faintly fibrillose at first, moist to dry (not viscid), base whitish, midportion orange, apex more or less concolorous with the gills; spores  $7-8 \times 3.5-4.5\mu$ , hyaline, smooth, ellipsoid, not amyloid; basidia  $30-35 \times 7-10\mu$ , four-spored, clavate and base not prolonged, usually with clamp connections; cheilocystidia and pleurocystidia not differentiated; pileus-trama homogeneous beneath a viscid pellicle; all tissues yellow in iodine, large lactifers present in the flesh and gill-trama,  $60-150 \times 5-10\mu$ , straight, curved or contorted, becoming very brilliant yellow in chloral-hydrate-iodine solution.

On humus, spring, summer and fall, in deciduous and conifer forests, Nova Scotia and Ontario in Canada; New York, Massachusetts, Pennsylvania, Virginia, North Carolina, Tennessee, Michigan, Washington and California in the United States.

According to our experience this is a common species and both of us as well as other American mycologists previously have very likely called it *H. chlorophanus*. After handling specimens of this species, the stipe often feels subviscid to lubricous. However, if one observes the condition of the stipe carefully before damaging it, he will see that it is not covered by a



Plate 11. *H. puniceus* Fr.  $\times 1$ .

gelatinous or viscid coating. The texture of the stipe is soft and delicate, thus causing it to bruise easily. Kauffman, in his unpublished notes recognized the fungus as a distinct species and separated it from *H. chlorophanus* by the character of the stipe emphasized above. In addition he also recognized *H. chlorophanus*. Ricken described the stipe of *H. chlorophanus* as "glanzlos, fast glatt, fast trocken" and so may have had *H. flavescens* instead. *Hygrophorus Marchii* Bres. is very close but differs, according to its description, in the brighter red colors. The colors of *H. flavescens*, and we have observed many collections, never are red. The



Plate 12. *H. laetissimus* Smith & Hesler, X1.



variation is to pale yellow, and forms which are almost pale sulphur yellow are not uncommon.

61. *HYGROPHORUS PUNICEUS* Fr. Plate 11.

Pileus 3-7 (9) cm. broad, obtusely conic and the margin incurved when young, becoming umbonate to plane, the margin sometimes remaining decurved and sometimes spreading or recurved, sometimes remaining broadly convex, surface glabrous, viscid, the margin sometimes translucent striate, color deep blood red over all at first, fading in streaks (as if hygrophanous) to near "zinc orange" (brilliant orange), in age pale orange over all; flesh thin, fragile, waxy, sordid watery-reddish orange, becoming pale orange-yellow, odor none, taste mild; no color change when bruised; lamellae subdistant (30-36 reach the stipe, 2-3 tiers of short individuals), broad (5-6 mm. near the stipe), bluntly adnate with a decurrent tooth at first, becoming adnexed and sometimes seceding in age, color reddish orange to pale yellow, edges even; stipe 4-9 cm. long, (5) 10-15 mm. thick, stuffed to hollow, equal or narrowed slightly at the base, sometimes slightly ventricose, base white or yellowish, remainder reddish but soon fading to orange or yellow, yellow to orange within, more or less fibrillose striate (the fibrils innate, and caused by the splitting of the cuticle); spores (7) 8-10 (12)  $\times$  5-6 $\mu$ , subellipsoid, smooth, hyaline, not amyloid; basidia 44-58  $\times$  8-10 $\mu$ , usually four-spored; cheilocystidia and pleurocystidia not differentiated; gill-trama of subparallel hyphae, the cells long and cylindric, basidia, subhymenium and trama all yellow in iodine; pileus-trama homogeneous beneath a gelatinous pellicle, all parts yellowish in iodine.

Gregarious to scattered under hardwoods or conifers, Nova Scotia, Ontario to Manitoba in Canada and Massachusetts, New York, Virginia, North Carolina, Alabama, Tennessee, Michigan, Washington, Oregon and California in the United States. Very common and widely distributed.

The viscid pileus, its deep blood red color and the somewhat fibrillose striate stipe are the important diagnostic characters of the species. We have not been able to verify the differences between *H. coccineus* and *H. puniceus* as pointed out by Kauffman. For a critical comparison of these two see *H. coccineus*. The spore size varies considerably in specimens with four-spored basidia. This added to the fact that two-spored forms are also known to occur (Bresadola, 1), makes spore size a rather poor character to use in distinguishing this species from its close relatives.

62. *Hygrophorus laetissimus* sp. nov. Plate 12.

Pileus 6-9 cm. latus, obtusus, demum planus, glaber, viscidus, laete coccineus; lamellae adnate, latae, subdistantes, crassae, laete ruber vel aurantiacae; stipes 4-6 cm. longus, 1-3 cm. crassus, aequalis, cavus, fragilis, sursum furfuraceus, deorsum glaber, albidus; sporae 7  $\times$  4-5 $\mu$ .

Pileus 6-8 cm. broad, obtuse, becoming nearly plane, glabrous, margin incurved at first, spreading in age, viscid, color "spectrum red" over the disc (more brilliant than scarlet red), the margin orange to yellowish and opaque, not fading appreciably; flesh dull yellow except for a thin red subseparable pellicle, odor and taste not distinctive; lamellae narrowly adnate to adnexed, broad (up to 8-10 mm.), subdistant ( $50 \pm$  reach the stipe), thick but the edges thin, "peach-red" (rufous with a tinge of pink) near the margin, "orange-chrome" near the stipe (brilliant orange); stipe 4-6 cm. long, 1-3 cm. thick, equal above a constricted base, hollow, fragile surface somewhat furfuraceous above, glabrous below, white, the base splashed with scarlet or yellow; spores  $7-9 \times 4-5\mu$ , smooth, hyaline, ellipsoid, not amyloid; basidia four-spored,  $42-50 \times 7-9\mu$ ; cheilocystidia and pleurocystidia none; gill-trama subparallel, the central area of cells having yellow contents, the subhymenium hyaline; pileus-trama homogeneous beneath a thick gelatinous pellicle.

Scattered under redwoods, Prairie Creek State Park, Orick, Calif. Nov. 27, 1937, A. H. Smith 9148-type.

The outstanding features of the species are its exceptionally brilliant red viscid pileus and white stipe. In its other characters it closely resembles *H. puniceus* and *H. coccineus*. Both of the latter have colored stipes and were collected along with *H. laetissimus* so that a comparison of fresh specimens was made. There is also a rather distinct difference in color between dried specimens. Those of the latter are a bright fiery orange compared to the duller colors of both the others. *H. Marchii* Bres. is also close to *H. laetissimus* but is illustrated and described as having a highly colored stipe and a much more slender stature.

### 63. *HYGROPHORUS SUBMINIATUS* Murrill.

"Pileus convex to plane, at length irregular, 1.5 cm. broad; surface viscid, smooth, miniatous, varying slightly in places, margin undulate; lamellae decurrent, few, whitish to ochraceous; spores oblong-ellipsoid, often constricted at the middle, smooth, hyaline, about  $9 \times 5\mu$ ; stipe terete, crooked, slightly enlarged above, glabrous, luteous, 3 cm. long, 2 mm. thick."

The type was collected in Jamaica. We were unable to locate it, and have quoted the original description. . . . During the season of 1941 a fungus was found at Olympic Hot Springs in the Olympic Mts. of Washington, which, to judge from the description, must be Murrill's species. It was found under conifers and Devil's club on wet soil, Sept. 22, 1941 (17170-S). The following is a description of these specimens:

Pileus 1-2.5 cm. broad, somewhat top-shaped at first, the margin bent in slightly, becoming broadly convex to obtuse or nearly plane, the margin remaining decurved, surface glabrous and viscid, hygrophanous and translucent striate when moist, "Grenadine red" over all and fading to

"orange buff" (usually on the disk first); flesh moderately thick and soft, concolorous with the pileus or watery orange, odor and taste not distinctive; lamellae rather distant (20-23 reach the stipe, 2 or 3 tiers of short individuals), moderately broad at least in the midportion, decurrent, pallid yellowish when young, becoming  $\pm$  concolorous with the pileus or "Mikado



Plate 13. *H. flavescentis* (Kauff.) Smith & Hesler,  $\times 1$ .

orange" with pale yellow edges; stipe 3-6 cm. long, 3-5 mm. thick, hollow,  $\pm$  equal, terete or compressed, flexuous and uneven or undulating, glabrous, moist, "light orange-yellow" over all; pileus trama homogeneous beneath a viscid pellicle; gill trama of large hyphae in a subparallel arrangement; basidia four-spored,  $46-54 \times 6-7\mu$ ; spores  $6-9 \times 3.5-4\mu$ , subcylindric to subballantoid, obtuse at the ends, not amyloid.

The species could easily be mistaken for a small *H. Cantharellus* but upon careful observation certain differences are evident. The most reliable of these is the shining pileus caused by the gelatinous pellicle.



64. *HYGROPHORUS TROYANUS* Murrill.

"Pileus subhemispheric to convex, solitary, 1-1.5 cm. broad, 3 mm. high; surface smooth, viscid when wet, ferruginous; lamellae decurrent, violaceous, distant, rather broad, two or three times inserted; spores ellipsoid,



Plate 14. *H. huronensis* Smith & Hesler,  $\times 1$ .

smooth, hyaline,  $7-9 \times 4-5\mu$ ; stipe glabrous, cylindric, lateritious above, paler below, changing to flavous at the base, 4 cm. long, 2.5 mm. thick."

The type was collected in Jamaica. The species is smaller than *H. coccineus*. The type was examined and found to have gelatinous hyphae over the surface of the pileus, subparallel gill-trama and spores as Murrill

described them. The spores as well as the gill-trama and flesh of the pileus were not amyloid. The stipe was not examined for gelatinous hyphae. The species should be readily distinguished by its ferruginous pileus and violaceous gills.

65. *HYGROPHORUS SUBCERACEUS* Murrill.

"Pileus convex to subexpanded, with a small broad umbo at times, gregarious, 1.5-2 cm. broad; surface rather viscid, smooth, glabrous, flavous tinged with luteous when young and at the center when mature; margin even, entire to slightly lobed; context very thin, flavous, odorless, mild; lamellae arcuate, short-decurrent, rather broad, inserted, medium distant, entire, pale-yellow, unchanging; spores subellipsoid, obliquely apiculate, smooth, hyaline, about  $5 \times 2.5\mu$ ; cystidia none; stipe subequal, often flattened, smooth, glabrous, concolorous or paler yellow,  $3-4 \times 0.2-0.3$  cm."

The type was collected in Florida. We have quoted the original account, but have seen no material.

66. *HYGROPHORUS FLAVOLUTEUS* Murrill.

"Pileus convex, solitary, 1.3 cm. broad, 5 mm. high; surface luteous, with faint traces of red, polished, slightly viscid, radiate striate; lamellae flavous, slightly ventricose, rather close, several times inserted, apparently free, but really connected by slender threads of tissue across the disk to which the stipe is attached; spores globose, regular, hyaline, uninucleate, smooth,  $4-5\mu$ ; stipe cylindric, equal, smooth, glabrous, citrinous, whitish-tomentose and slightly enlarged at the base, 2.2 cm. long, 1.5 mm. thick."

The type was collected in Jamaica. We were unable to locate it and have quoted the original account.

67. *HYGROPHORUS FORNICATUS* Fr.

Pileus 4-6 cm. broad, obtuse when young, the margin incurved, becoming obtusely umbonate with an expanded plane margin, the margin finally somewhat wavy and splitting radially, glabrous, viscid (the pellicle separable as a thin skin), color white or tinged pale gray over the disc, margin faintly translucent striate when moist, no color change when bruised; flesh firm, thin, waxy, odor and taste none, no color change noted; lamellae sinuate to adnexed, subdistant, broad, white, thickish, firm, rigid, waxy, intervenose, white, edges even, not changing color when bruised; stipe 3-6 cm. long, 1-1.5 cm. thick at the midportion, flaring at the apex or equal, hollow or soon becoming so, surface moist but not viscid, with scattered innate appressed silky fibrils, apex somewhat fibrillose-scabrous, white over all; spores  $7-9 \times 4.5-5\mu$ , broadly ellipsoid, smooth, not amyloid;

basidia four-spored,  $38-44 \times 6-8\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of subparallel hyphae  $10-15\mu$  thick, lactifers present; pileus-trama homogeneous beneath a thick gelatinous pellicle.

Singly under redwoods, Orick, Calif. Dec. 4, 1937 (9394-S) and Dec. 6 (9459-S).

This species appears to be very rare in North America. According to our limited experience it is not truly white. It is close to *H. acutus*, but readily distinct as pointed out under that species. Its relationships appear to be with *H. ovinus* but is not likely to be mistaken for either that species or *H. nitratus*.

### Section VISCIDIPEDES

Here are grouped those species with both the pileus and the stipe viscid. We know of no forms having viscid stipes and dry or merely moist pilei. The section is divided into two groups, the brightly colored forms and those with dull colors.

#### 1. *Laeti*

##### 68. *HYGROPHORUS CHLOROPHANUS* Fr.

"Pileus 2-5 cm. broad, convex or campanulate, then nearly plane, obtuse, *viscid*, citron, sulphur or golden yellow, glabrous, sometimes pellucid-striate on the margin. Flesh *fragile*, not becoming black when bruised. Gills *adnexed*, *ventricose*, *becoming emarginate*, *thin*, subdistant, rather broad, pale citron-yellow, trama of parallel hyphae. Stem 3-7 cm. long, 4-8 mm. or less in thickness, *equal* or nearly so, sulphur or pale citron-yellow, *unicolorous*, hollow, rarely compressed, *viscid*, glabrous, even. Spores narrowly elliptical,  $6-8 \times 4-5\mu$ , smooth.

"Gregarious. Low, moist places in woods. Throughout the state. June-September. Common.

"Known by its unicolorous viscid stem and the adnexed, rather broad gills. The stem often dries quickly when exposed to the wind. Var. *flavescens* of the preceding species is almost as closely allied to this species, but its stem is fundamentally distinct."

Since neither of us has collected a fungus of this kind with a viscid stipe, we have quoted Kauffman's (6) account. We have examined many of Kauffman's specimens of *H. chlorophanus* under the microscope, but have failed to find gelatinous hyphae over the surfaces of the stipes in any of them. However, in view of the difficulty of demonstrating this character from dried specimens, we do not feel justified in attributing the statements of both Kauffman and Peck (14) to incorrect observation or interpretation. More than likely there will come a season when a viscid-stiped species of this stature and color is common and the apparent discrepancy which has resulted from a study of the dried specimens will be explained.





Plate 15, a. *H. unguinosus* Fr.  $\times 1$ ; b. *H. parvulus* Peck,  $\times 1$ .

# 69. HYGROPHORUS CERACEUS Fr.

Pileus 1-4 cm. broad, convex when young, the margin scarcely incurved, becoming broadly convex or obtuse in age, at times the disc flattened or slightly depressed, glabrous and slightly viscid, hygrophanous and translucent striate to the disc when moist, "light orange-yellow" fading to "straw-yellow" (bright yellow moist, pale yellow and opaque when faded), not becoming white in age; flesh yellowish, very soft and fragile, odor and taste

not distinctive; lamellae broadly adnate to subdecurrent, broadest at base and sometimes almost triangular, subdistant, thickish, pale yellow to nearly white, edges even; stipe 2-5 cm. long, 2-4 mm. thick, equal, terete or compressed, hollow, glabrous, slightly viscid but soon dry, often undulating, concolorous with the pileus, glabrous; spores  $6-8 \times 4-5\mu$ , broadly ovoid to subellipsoid, hyaline, smooth, yellowish in iodine; basidia four-spored,  $32-43 \times 6-7\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of interwoven hyphae but the cells broad as in most *Hygrocybes*; pileus-trama homogeneous, the pellicle gelatinous but very poorly differentiated and very thin.

Scattered to gregarious on moss and soil, New York, Pennsylvania, North Carolina, Tennessee, Alabama, Michigan, Washington and Oregon.

The viscid pellicle is very difficult to demonstrate in dried material because of its poor organization. The same is true for the gelatinous layer over the stipe. In studying only dried material one would very likely conclude that neither the pileus nor the stipe were viscid. The less depressed pileus, more adnate gills and failure of the pileus to fade to white distinguish *H. ceraceus* from *H. nitidus*.

#### 70. *HYGROPHORUS NITIDUS* B. & C. Plate 16, b.

Pileus 1-4 cm. broad, when young broadly convex or flattened and with an incurved margin, disc very soon becoming depressed, in age deeply infundibuliform, the margin either spreading or remaining decurved, glabrous, striatulate when moist, viscid, wax yellow to lemon yellow ("primuline yellow") over all at first, fading to whitish or pale cream color; flesh very soft and fragile, thin, yellowish, fading to white, odor and taste not distinctive; lamellae arcuate at first but soon long-decurrent, subdistant to distant, narrow to moderately broad in age, pale yellow, intervenose, edges even, very fragile and easily broken; stipe 3-8 cm. long, 2-5 mm. thick, fragile, equal or slightly enlarged above, hollow, flexuous at times, surface viscid and glabrous, glistening when dry, concolorous with the pileus at first, fading to whitish; spores  $7-8 \times 4-5\mu$ , subovoid, not amyloid; basidia four-spored,  $34-38 \times 5-7\mu$ , cheilocystidia and pleurocystidia not differentiated; gill-trama of interwoven to subparallel hyphae of very large cells ( $100-135 \times 30\mu \pm$ ); pileus-trama homogeneous beneath a thick gelatinous pellicle; clamp connections present.

Gregarious to scattered on humus, Nova Scotia and Ontario in Canada and Pennsylvania, Michigan, Washington and Tennessee in the United States. Murrill reports its distribution as Eastern United States. Peck found it in New York.

This is a very common species in the early summer in southern Michigan where it usually appears in bogs or on very wet soil. It was described from

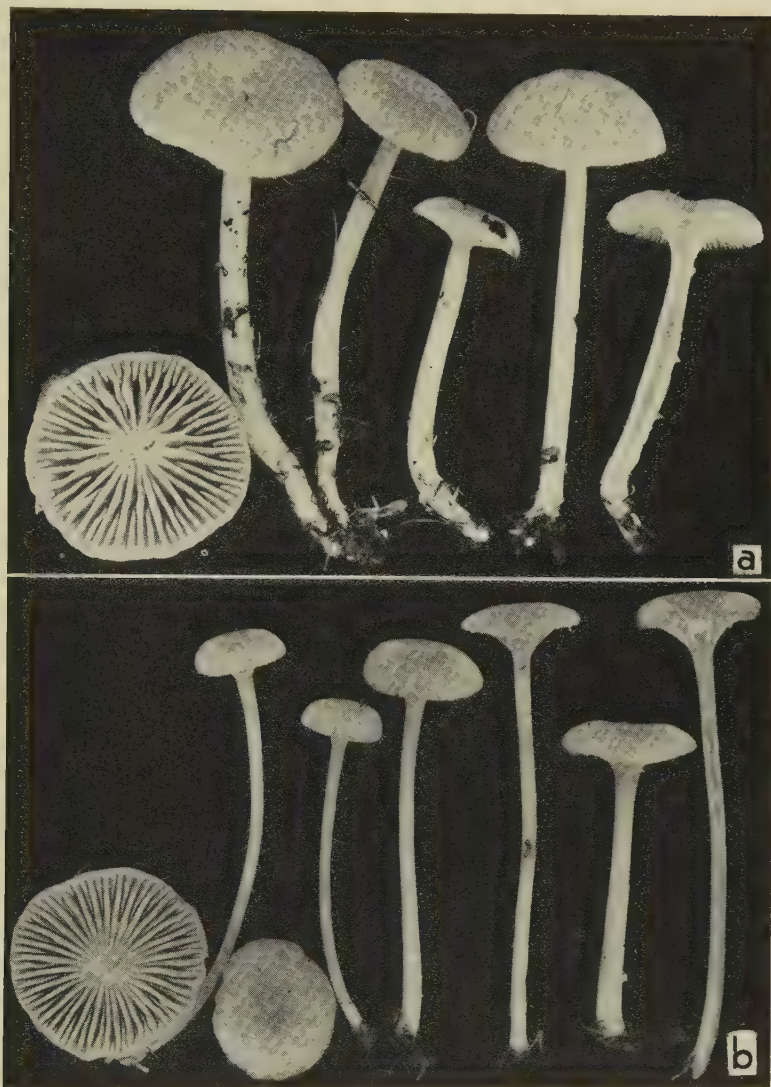


Plate 16, a. *H. laetus* Fr.  $\times 1$ ; b. *H. nitidus* B. & C.  $\times 1$ .

South Carolina and has been found throughout most of northeastern United States. It is easily recognized by its pale yellow colors, which characteristically fade to whitish, its long-decurrent gills, relatively long slender stipe, umbilicate to infundibuliform pileus and very soft consistency. *H. vitellinus* Fr. is a synonym and the name frequently used in Europe.



71. *HYGROPHORUS NITIDUS* var. *LUTEUS* Murrill.

"Pileus convex or slightly depressed, usually papillate, gregarious, 1-2 cm. broad; surface moderately viscid, uniformly luteous, glabrous, margin entire, sulcate; lamellae arcuate, broad behind, distant, decurrent, inserted, entire, yellow; spores ellipsoid or ovoid, smooth, hyaline, granular,  $6-8 \times 4-5\mu$ ; cystidia none; stipe usually slightly tapering downward, viscid, smooth, concolorous, glabrous,  $3-6 \times 0.2-0.3$  cm."

The type was collected in Florida. We have quoted the original description. Judging by the description, the variety appears to be indistinguishable from *H. ceraceus*. *H. citrinus* Rea is also close to Murrill's variety but supposedly differs in paler color and closer gills.

72. *Hygrophorus flavifolius* sp. nov.

Pileus (1) 2-4 cm. latus, obtuse, conicus, demum convexus, glutinosus, luteus demum pallidus, striatus; lamellae late adnatae, subdistantes, latae, laete flavae; stipes 4-5 cm. longus, 3-7 mm. crassus, aequalis, cavus, glutinosus, candidus; sporae  $7-9 \times 4-5\mu$ .

Pileus (1) 2-4 cm. broad, obtusely conic, becoming convex to nearly plane, glabrous and translucent striate to the disc, entire surface slimy-viscid, color evenly "apricot yellow" (a full bright yellow), soon fading to whitish over the disc, in age yellowish only along the margin, pallid over all when dried; flesh whitish, thin, fragile, odor and taste mild, no color change on bruised portions; lamellae broadly adnate, subdistant, broad, veined at the base, "cadmium-yellow" (brilliant orange-yellow) and retaining their color when dried, not fading in age, edges even; stipe 4-5 cm. long, 3-7 mm. thick, equal or narrowed below, hollow, very slimy-viscid (as in *H. laetus*), white at all stages; spores  $7-9 \times 4-5\mu$ ; smooth, hyaline, ellipsoid, not amyloid; basidia four-spored  $38-46 \times 5-6\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of interwoven hyphae, the cells large ( $10-15\mu$  in dia.) and slender filaments intertwined among the broad ones, lactifers also present, subhymenium not gelatinous; pileustrama homogeneous beneath a thick gelatinous pellicle.

Gregarious under redwoods, Prairie Creek State Park, Orick, Calif. Nov. 28, 1937, A. H. Smith 9164-type.

This very distinct species is well characterized by its obtuse yellow glutinous pileus, persistently bright colored gills and very glutinous stipe. It is closely related to *H. psitticinus* but differs in color at all stages.

73. *HYGROPHORUS LAETUS* Fr. Plate 16, a.

Pileus 1-3.5 cm. broad, convex when young, becoming plane or with a depressed disc, the margin sometimes turned up giving the cap a sub-infundibuliform appearance, glabrous, very slimy-viscid, translucent-striate, color extremely variable, often sordid olivaceous orange when young and becoming "Mars orange" to "orange-rufus" at maturity, some-

times "tawny-olive," "buff-orange," "pinkish buff" or "onion-skin pink," at other times "pale violet gray" or "light vinaceous gray" (various mixtures of olive, pink, yellow, brown and sometimes violet to vinaceous gray), flesh thin, tough, concolorous with the surface or paler, odor none or faintly disagreeable, taste not distinctive; lamellae adnate to decurrent, pliant, subdistant, narrow to moderately broad, variously colored (like the pileus) pinkish, pale violet-gray or light vinaceous gray and becoming "buff pink," the edge at times pinkish purple; stipe 3-12 cm. long, 2-4 (6) mm. thick, even, hollow, fairly pliant, glabrous, slimy viscid, more or less concolorous with the pileus, the apex often "pale violet-gray," spores  $5.5-7$  ( $8$ )  $\times$   $3-4\mu$  broadly ellipsoid, smooth, not amyloid; basidia  $28-36 \times (4) 5-7$  ( $8$ )  $\mu$ , two- or four-spored; gill-trama or parallel to subparallel hyphae, the subhymenium usually more or less gelatinizing; cheilocystidia in the form of slender filaments  $25-49 \times 1.5-2.5\mu$ , projecting from the gill-edge; pleurocystidia none; pileus-trama homogeneous beneath a thick gelatinous pellicle.

Gregarious on moss in bogs or on damp soil in woods, common during the summer and fall. Material has been examined from Nova Scotia and Ontario in Canada and from New York, Pennsylvania, Maryland, North Carolina, Tennessee, Michigan, Idaho and Washington in the United States.

We consider *H. Peckii* Atk. to be a synonym of *H. laetus*. The species is a very variable one in many characters. On material from Michigan the spores from deposits measure  $5-6 \times 3-3.5\mu$ . On specimens from Tennessee they were  $6-8.5 \times 4-5\mu$ . An examination of a series of specimens, however, showed considerable intergradation. Consequently we do not regard the difference in spore size as significant. It might be added that a range in size of from  $5-6 \times 3-3.5\mu$  is smaller than the range usually given for either *H. Peckii* or *H. laetus*.

*Hygrophorus Davisii* Peck appears to be merely a form of *H. laetus* with pallid gills at first and a pallid stipe. In the dried condition the type was indistinguishable from dried specimens of *H. laetus*. Both have the characteristic pinkish color in all parts of the fruiting body. Microscopically it is also identical with *H. laetus*. The filamentose cheilocystidia are present, the spores measure  $5-7 \times 3-4\mu$ , and were not amyloid. The gelatinous layers of the pileus and stipe were easily demonstrated. We have frequently collected forms with pallid gills and stipe and referred them to the Friesian species because of the color changes which took place as the specimens aged. Kauffman and Smith (8) reported *H. Davisii* from Rock River, Mich. The report was based on specimens with pallid gills and stipes.

#### 74. HYGROPHORUS HONDURENSIS Murrill. Plate 17.

"Pileus convex to plane, slightly depressed, solitary, 1-1.5 cm. broad,



FIGURE 1. *L. longistylis* Merrill.

surface luteous, very viscid, radiate-striate; lamellae short decurrent, rather narrow, inserted; spores ovoid, smooth, hyaline,  $5 \times 3.5\mu$ ; stipe equal, concolorous, very viscid, 3-4 cm. long, 1-2 mm. thick."

The type was collected in British Honduras. We have quoted the original description. The type is very similar to *H. laetus* but has dried a dull yellow instead of pinkish. There is a very thick mass of gelatinous hyphae over the pileus and stipe. The gill-trama is subparallel and yellowish in iodine. The spores are as Murrill described them and not amyloid. No cheilocystidia are present.

A form intermediate between *H. laetus* and *H. hondurensis* was found in a pasture at Cape Flattery, Wash. Oct. 19, 1941 (18021-S). It is much more cartilaginous than *H. laetus*, dries a dull yellow instead of pink and has gelatinous cheilocystidia, a thick gelatinous subhymenium and also thick gelatinous layers over both pileus and stipe. The fresh fruiting bodies were a clear pale yellow and faded as if hygrophanous to nearly white. When dried, however, all pilei regained their yellow color. In all probability these specimens should be classified in *H. hondurensis*. We believe it likely that future studies of *H. hondurensis* from the American tropics will reveal that it characteristically has the filamentous cheilocystidia.

#### 75. HYGROPHORUS PSITTICINUS Fr.

Pileus 1-3.5 cm. broad, conic to campanulate or finally convex to plane, sometimes remaining umbonate, glutinous or very viscid when moist, appearing as if varnished when dry, translucent striate at first, opaque when faded, color parrot-green when young and fresh, soon fading or changing color to rufous, tawny, pinkish flesh-color or sordid yellowish, usually drying bright pale incarnate; flesh thin, concolorous with the surface more or less, fragile (but somewhat tenacious because of the thick pellicle), odor and taste not distinctive; lamellae adnate, narrow to broad or subventricose at times, subdistant, greenish at first, soon reddish or yellow ("cadmium-yellow" to "light cadmium"), edges even; stipe (2) 3-7 cm. long, 2-5 mm. thick, equal, hollow, somewhat pliant, surface even or undulated, somewhat translucent, green above or almost over all when real young, soon changing color to yellow or orange, in age pinkish like the pileus, very slimy viscid throughout its entire length; spores (6) 7-9 (10)  $\times$  4-5 $\mu$ , ellipsoid, smooth, not amyloid; basidia four-spored, 38-46  $\times$  6-7 $\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill trama of subparallel hyphae, yellowish in iodine; pileus-trama homogeneous beneath a thick gelatinous pellicle, all parts yellowish in iodine.

Gregarious to scattered in conifer and hardwood forests or in pastures, along roadsides etc. Specimens have been examined from Nova Scotia, Ontario and British Columbia in Canada and from New York, Maryland, Tennessee, North Carolina, Michigan, Washington and California in the United States.



The spore size is usually slightly larger than given by Kauffman (6-7.5  $\times$  4-5 $\mu$ ). Smith, however, has found this small spored form in the vicinity of Ann Arbor. As Kauffman pointed out, there is little danger of anyone confusing *H. psitticinus* with any other species if the young stages are found. After specimens have changed color, one might easily confuse them with *H. laetus*, and dried specimens of the two are indistinguishable macroscopically.

76. *HYGROPHORUS PURUS* Peck.

Pileus (2.5) 4-7.5 cm. broad, conic, conic-campanulate, broadly conic, or with the margin recurved in age, white, tinged pinkish red where wounded, glabrous, viscid, finely rivulose under a lens, margin pellucid-striate; flesh thin, white, very waxy, odor none, taste mild; lamellae unciniate, subdistant, rather broad, ventricose, snow-white, edges even; stipe 4-8 cm. long, 3-8 mm. thick, with a large hollow, equal or tapered slightly either way, sometimes flexuous or at least curved at the base, glabrous, white and shining, glutinous, base tinged pinkish red where wounded; spores ellipsoid, 7-9  $\times$  4.5-5 $\mu$ , smooth, yellowish in iodine; basidia four-spored, 40-58  $\times$  6-7 (8) $\mu$ ; cheilocystidia and pleurocystidia not differentiated; gill-trama of interwoven-subparallel hyphae, yellowish in iodine; pileus-trama homogeneous beneath a gelatinous pellicle.

On humus under hardwood and hemlock. Specimens from North Carolina have been studied. It was described from New York.

*H. purus* has much the stature of *H. amoenus*, but the glutinous stipe at once distinguishes it entirely apart from the color. In cross section the stipe is seen to possess a thick outer coating of slender gelatinous hyphae similar to that found in *H. psitticinus*. Similar hyphae project from the surface of the pileus and become matted together forming the viscid pellicle. Ordinarily both surfaces appear glabrous. Although the gill-trama is made up of interwoven hyphae the cells are large and not as tangled as in the true *Camarophylli*.

77. *HYGROPHORUS RUBER* Peck.

"Pileus thin, conic, commonly unexpanded, acute or subobtusate, cuspidate or narrowly umbonate, very viscid or glutinous, bright red, not turning black in drying; lamellae narrow, ascending, adnexed, subdistant, yellow or yellowish brown; stem equal, viscid, hollow, colored like the pileus; spores subelliptic, .00024-.0003 of an inch long, .00016-.0002 broad.

"Pileus .5-2 inches broad; stem scarcely 1 inch long, 1 line thick. Among mosses in wooded swamps. Ellis, Stow, Cohasset, Mass. September. G. E. Morris.

"Distinct from *H. conicus* in its usually smaller size, more viscid pileus, bright red stem and persistent unchanging color in drying."

The above is Peck's original description and comments. We have not seen fresh specimens. An examination of the Ellis specimens showed that

the pileus possessed a distinct gelatinous pellicle. The stipe was not sectioned. The gill-trama was found to be parallel and to contain scattered lactifers. The basidia were four-spored and  $24-35 \times 6-7\mu$ . No cystidia were found on either the sides or edges of the gills, and the spores measured  $6-8(9) \times 4-5\mu$ . The latter were broadly ellipsoid, smooth and not amyloid.

By virtue of its conic pileus, viscid pileus and stipe, bright red colors and small spores it is a very distinct species. It should be readily distinguished from *H. cuspidatus* by its viscid stipe and small spores, but is apparently very closely related to the following species.

78. *HYGROPHORUS PERSISTENS* Britz.

Pileus quite viscid, yellow, yellowish red, conic but also campanulate and expanding, 8 cm. broad; stipe 11 cm. high, 4, mm. thick, enlarged toward the base, hollow, colored like the pileus, viscid; lamellae adnate, 10 mm. broad, pale yellowish; flesh also yellowish and not blackening; spores  $10-16 \times 6-10\mu$ .

The above is taken from Britzelmayr's revised description. The following description is that of *H. californicus* given by Murrill.

"Pileus conic, cuspidate, gregarious, 5 cm. broad; surface orange or reddish, smooth, glabrous, decidedly viscid, not blackening on drying, margin somewhat lobed, concolorous: context very thin; lamellae adnate, yellow or nearly white, rather broad and distant: spores ellipsoid, smooth, hyaline,  $9-12 \times 6-8\mu$ : stipe thick, equal, concolorous, hollow, smooth, glabrous, somewhat viscid, 7-9 cm. long, about 1 cm. thick."

On the basis of these two descriptions we believe that Murrill's species is synonymous with that of Britzelmayr. However, we are inclined to question whether *H. californicus* actually does have a viscid stipe. We suspect that, as in *H. Langii*, the stipe may merely feel slightly sticky at times, and that there is no covering of gelatinous hyphae. We failed to find evidence of such a covering in our study of the type. However, this is not conclusive evidence that such a covering did not exist. It appears that Murrill described the species from notes sent to him by the collector. According to our own experience, in cases where a false viscosity may be present, the notes of an amateur collector will nearly always describe the part in question as viscid because it is somewhat sticky to the touch. Singer (18) has apparently assumed that the stipe of *H. persistens* is not viscid, which accounts for the synonymy he suggested. If Singer is right, and our opinion in regard to *H. californicus* is right, both species should be discarded as it does not seem advisable to select a name based on an error of description. We recognize *H. persistens* here because of its similarity to *H. ruber* Pk. However, the same objection which we raised in regard to the viscosity of the stipe in *H. californicus* also applies to Peck's species. These questions obviously must be settled by a study of fresh specimens, if any can ever be found.

79. *HYGROPHORUS SUBRUBER* Murrill.

"Pileus conic with a conic umbo, gregarious, 3-5 cm. broad; surface viscid, glabrous, uniformly luteous when young, becoming flavous except at the center, margin becoming striate, rimose and much upturned in age; context very thin, subluteous, odorless, mild; lamellae adnexed, ventricose, broad, inserted, citrinous, edges becoming very uneven, fragile and rimose; spores oblong-ellipsoid, smooth, hyaline, granular,  $10-12 \times 5\mu$ ; cystidia none; stipe equal, smooth, glabrous, viscid, subluteous, white at the base,  $6-8 \times 0.7$  cm."

The type was collected in Florida. We have not examined it, but question whether the species is distinct from *H. Langii*. Kauffman and Smith (8) reported the stipe of that species as viscid, but later study showed this to be an error. The stipe may feel slippery or slightly sticky after being handled, but this is caused by the soft moist texture rather than by typical gelatinous hyphae.

80. *HYGROPHORUS SCIOPHANUS* Fr. sensu Coker.

"Cap 1.5-2.5 cm. broad, umbonate, plane or convex at maturity, glutinous, hygrophanous, dull watery reddish orange and striatulate with color when wet, a much paler pinkish rose or yellowish pink when dry; margin somewhat crenated. Flesh pale orange, nearly white when dry, about 1 mm. thick at center, odorless and tasteless.

"Gills distant, adnate or sinuate-adnexed, 2-2.5 mm. broad, ventricose, interveined, a beautiful orange red at all ages, about bitter-sweet orange of Ridgway but richer.

"Stem about 2.5-4 cm. long, 2-3.5 mm. thick, equal, glutinous, often flattened, quite smooth all over, stuffed then hollow, color of the cap.

"Spores ovate-elliptic to tear-shaped, smooth with a large mucro,  $3.7-4.4 \times 6.6-8\mu$ .

"Easily distinguished by its beautiful gills, the margin *not* darker and by the glutinous cap and stem, the latter quite glabrous above as well as below.

"This species has not been recognized heretofore in this country. It agrees in all essentials with European descriptions and is well represented in Bresadola's plate 339 (Icon. Myc. 7) and by Fries's plate 167 fig. 1 (Icon. Selectae)."

We have not seen American specimens referable to this species and recognize it on the basis of Coker's description which is quoted above. Specimens from Jossierand, collected near Lyon, France, are quite distinct from *H. minutulus* in the dried condition. These two species, however, are closely related. For additional comments see *H. minutulus*.

81. *HYGROPHORUS REAI* Maire.

Pileus 1-3 cm. broad, convex when young, the margin minutely crenate,

becoming broadly convex in age, glabrous, viscid, the pellicle very bitter, faintly translucent striate toward the margin, "Grenadine red" to "flame scarlet" (brilliant red) on the disk, "deep chrome" (brilliant orange) toward the margin, in age fading to "deep chrome" over all; flesh concolorous with the surface and fading with it, brittle, thin (1.5–2.5 mm. near the stipe), odor none, taste very bitter; lamellae subdistant (18–24 reach the stipe), 2 tiers of short individuals, broad (4–6 mm.), bluntly adnate and soon seceding, "light buff" when young, becoming "straw yellow" (whitish and becoming pale yellow), edges even; stipe 3–5 cm. long, 1.5–3.5 mm. thick at apex, usually narrowed below, hollow, very fragile, glabrous, viscid and shining, often translucent with an undulating surface, paler than the pileus or concolorous with it toward the base; pileus-trama homogeneous beneath a thin gelatinous pellicle; gill-trama of very large cells rather intricately interwoven; basidia four-spored; spores  $6.5-8 \times 4-5\mu$ , not amyloid.

Gregarious under conifers, Olympic Hot Springs, Olympic Mts. Wash., Oct. 17, 1941 (18009-S). The above description was drawn from this collection. Rea and Ramsbottom (16) reported collecting the species in New York at the time of the International Congress at Ithaca. Kauffman had one collection from the Adirondacks Mts. of New York which was made by F. C. Stewart in 1924.

The bitter pellicle of the pileus and the distinctly interwoven gill trama appear to distinguish *H. Reai* from *H. minutulus*, but in all other characters the two are very similar.

## 82. HYGROPHORUS MINUTULUS Peck.

"Pileus very thin, submembranaceous, convex or expanded, subumbilicate, bright red or orange, viscid, distinctly striatulate when moist, pale red or yellowish when dry; lamellae rather broad, subdistant, sometimes ventricose, adnate or subsinuate and slightly decurrent, whitish tinged with red or yellow; stem short, slender, fragile, solid, viscid when moist, yellowish; spores narrowly elliptic, .0004 of an inch long, .0002 broad, sterigmata .0002–.0003 of an inch long.

"Pileus 3–5 lines broad; stem 6–10 lines long, less than .5 of a line thick.

"Grassy and mossy places in pastures. Rensselaer county. July. Rare. Found but once.

"This is one of our smallest species. Its solid stem does not agree well with the character of the subgenus in which we have placed it, but its bright color indicates its relationship to the species of this subgenus."

The description and comments are quoted from Peck's (14) account of the New York species. The only collection located at Albany was that of Burnham, dated 1909. We have a few collections from North Carolina however, which appear to belong here. The following are our notes:

Pileus 5–15 mm. broad, convex when young, becoming broadly convex



to plane, the disc not depressed, surface glabrous and distinctly viscid, "scarlet" "flame scarlet" to "Mars orange" (brilliant red to brilliant orange), hygrophanous, fading to "antimony-yellow" (pale bright yellow), margin striatulate when fresh; flesh thin, fragile, concolorous with the surface, odor and taste mild; lamellae adnate to adnexed or with a decurrent tooth, close to subdistant, broad and somewhat ventricose, reddish orange ("orange-buff" to "bittersweet-orange"), edges even; stipe 1.5-5 cm. long, 1-3 mm. thick, fragile, equal or tapering downward, stuffed, becoming tubular, at first red over the upper part, yellowish below or whitish at the base, fading to yellow over all in age; spores (6) 7-8(10.3)  $\times$  3.5-5(6) $\mu$ , ellipsoid, not amyloid; basidia four-spored, 32-45  $\times$  5-8 $\mu$ ; cheilocystidia and pleurocystidia none; gill-trama of parallel to subparallel hyphae, yellow in iodine, cells 6-12(15) $\mu$  broad; pileus-trama homogeneous beneath a gelatinous pellicle.

The color of the gills in these specimens is nearly the same as that given by Coker for his material of *H. sciophanus*. Murrill's *H. subminutulus* and *H. Reai* var. *insipida* Lange also appear to be intermediate forms between *H. sciophanus* and *H. minutulus*. The arcuate gills and spores 5-6 $\mu$  long of *H. subminutulus*, in our estimation, are not sufficient to distinguish it. Murrill also emphasized the short stipe, but if his description is compared with that of Peck it will be found that there is no difference. However, since we have not been able to see material of *H. subminutulus* we quote the original account here in order to bring all the information together:

"Pileus convex to subexpanded, rarely depressed, gregarious, 7-10 mm. broad; surface viscid, smooth, glabrous, red, soon fading to yellow but often retaining the red color in the center, margin even, entire; lamellae arcuate, decurrent, distant, broad, inserted, entire, pale-yellow; spores ellipsoid, smooth, hyaline, granular, obliquely apiculate, 5-6  $\times$  3-4 $\mu$ ; cystidia none; stipe viscid, smooth, glabrous, tapering downward, red, not soon fading, 1.5-2.5  $\times$  0.1-0.2 cm." The type was collected in Florida.

It is possible that *H. sciophanus* of Coker, the collections we have referred to *H. minutulus*, and Murrill's *H. subminutulus* should all be grouped in one species. If so, we believe the oldest American name, *H. minutulus*, should be used at least until the discrepancy between the European specimens of *H. sciophanus* and American material is cleared up.

## 2. *Obscuri*

### 83. *HYGROPHORUS UNGUINOSUS* Fr. Plate 15, a.

Pileus (1) 2-4 (5) cm. broad, hemispheric becoming convex and finally nearly plane, occasionally obtusely conic and remaining slightly umbonate when expanded, glabrous, slimy viscid when moist, shining when dry, blackish to umber or dark grayish brown, becoming smoke gray on the disc and pallid along the margin in age, translucent striate; flesh thin and

very soft and fragile; white, odor none, taste mild; lamellae adnate to slightly adnexed, broad, at times subventricose, thick, subdistant, intervenose, white or shaded pale gray, edges even; stipe 3-8 cm. long (2) 3-6 (8) mm. thick, tubular to hollow, equal and flexuous, very fragile, glabrous, very slimy and viscid moist, appearing as if varnished when dry, concolorous with or paler than the pileus; spores (6) 7-9 (10)  $\times$  4-5 $\mu$ , ellipsoid, yellowish in iodine; basidia 32-44  $\times$  7-8 $\mu$ , four-spored; cheilocystidia and pleurocystidia none; gill-trama of subparallel to somewhat interwoven hyphae, yellowish in iodine; pileus-trama homogeneous beneath a thick gelatinous pellicle, all parts yellowish in iodine.

Singly to scattered on rich humus in woods and swamps, summer and fall, Nova Scotia and Ontario in Canada, New York, North Carolina, Tennessee, Michigan and California in the United States.

A striking species because of its contrasting gray to dark umber colors and whitish to pale gray gills. It appears to be rare but widely distributed. Bresadola (1) has found a two-spored form with spores 8-9  $\times$  7 $\mu$ . *H. irrigatus* was placed by Fries in *Camarophyllus* but Konrad (10) places it in synonymy with *H. unguinosus*, a disposition which we believe is correct. *H. luridus* B. & C. sensu Peck (14) and Coker (2) does not appear to be distinct from *H. unguinosus*. Both are characterized by their dark colors, very viscid stipes and whitish to pale grayish gills. Neither Coker nor Peck discussed *H. luridus* in relation to *H. unguinosus*. Our specimens from Tennessee and North Carolina are all referable to the Friesian species.

#### 84. *Hygrophorus unguinosus* var. *subaromaticus* var. nov.

Pileus 2-5 cm. latus, planus, glutinosus, olivaceo-cinereus vel sordide olivaceo-brunneus; odor subaromaticus; lamellae pallidae, adnatae, latae, subdistantes; stipes 5-6 cm. longus, 6-10 mm. crassus, cavus, fragilis, glutinosus, pallidus; sporae 7-9  $\times$  4-5.5 $\mu$ .

Pileus 2-5 cm. broad, convex with an incurved margin, becoming plane or nearly so, glabrous, slimy viscid, margin striatulate, color "buffy brown" on the disc, "pale olive-buff" near the whitish margin, (a dull olive grayish brown to pallid); flesh thin, very soft and fragile, whitish, taste mild to slightly disagreeable, odor faint but disagreeably subaromatic; lamellae white with a faint gray cast, bluntly adnate with a decurrent tooth, broad, subdistant, edges even; stipe 5-6 cm. long, 6-10 mm. thick, equal, hollow, fragile, slimy viscid as in *H. laetus*, glabrous, concolorous with the gills when fresh but drying pale gray like the pileus, spores 7-9  $\times$  4-5.5 $\mu$ , ellipsoid, smooth, not amyloid; basidia four-spored, 46-52  $\times$  7-9 $\mu$ ; cheilocystidia not differentiated; gill-trama of subparallel hyphae, yellow in iodine; pileus-trama homogeneous beneath a thick gelatinous pellicle.

Under redwoods, Prairie Creek State Park, Orick, Calif, Nov. 28, 1937, A. H. Smith 9167-type.

## APPENDIX

## REVISED KEY TO THE SUBGENUS LIMACIUM\*

1. Stipe viscid or glutinous from the remains of a gelatinous universal veil. . . . . 2
1. Stipe dry or moist, sometimes subviscid to the touch but the veil, if present, not gelatinous. . . . . 5
2. Pileus white with yellow granules at least along the margin of the pileus and near the apex of the stipe. . . . . *H. chrysodon* p. 13
2. Not with the above combination of characters. . . . . 3
3. Pileus white or pale yellow only on the disc, not brown, red, bright yellow or gray. . . . . 9
3. Pileus colored more or less over all. . . . . 4
4. Pileus dominantly yellow, olive yellow (olive brown on disc), orange or bright red on the disc at maturity. . . . . 15
4. Pileus tawny, russet or dark pinkish tan. . . . . 24
4. Pileus cinereous to fuliginous or blackish. . . . . 17
5. Gills soon pink or stained with pink or pale brownish, ocher-salmon color, dark testaceous or sordid wine color. . . . . 8
5. Gills not as above (flushed pale pinkish in *H. calophyllus*, *H. fragrans* and *H. pudorinus* at times). . . . . 6
6. Pileus white or creamy on the disc (tinged tan in *H. pusillus*, see *H. fragrans* f. *pallidus* also). . . . . 28
6. Pileus not white or whitish. . . . . 7
7. Pileus pale pinkish tan, salmon color or pinkish buff, sometimes tawny to russet. . . . . 32
7. Pileus cinereous, fuliginous to blackish. . . . . 45
8. Gills pale pinkish brown when young, dark testaceous at maturity, never spotted. . . . .
- . . . . . *H. Kauffmannii* p. 44
8. Gills ochraceous salmon to pinkish-cinnamon. . . . . *H. saxatilis* (No. 10)
8. Gills distinctly reddish spotted or in age becoming entirely pink or sordid wine color. . . . . 38
9. Pileus not pure white. . . . . 12
9. Pileus pure white. . . . . 10
10. Lamellae sinuate. . . . . *H. eburneiformis* p. 8
10. Lamellae decurrent or bluntly adnate. . . . . 11
11. Stipe 1.5–3.5 cm. thick, tapered downward, equal or bulbous and tapered below the bulb. Pileus 5–14 cm. . . . . *H. ponderatus* p. 9
11. Stipe 2–8 (15) mm. thick, slender, equal or tapered to a vermiform base, pileus 2–7 (10) cm. broad. . . . . *H. eburneus* p. 7
12. Pileus whitish, disc often tinged yellow and becoming more or less yellowish in age or on drying. . . . . 13
12. Disc of pileus laved with pale pinkish tan. . . . . *H. laurae* p. 12
13. Upper portion of stipe when dried with reddish brown glandular dots (when fresh scurfy-punctate above, the points tending to stain sordid yellowish). . . . . *H. rubropunctus* p. 9
13. Upper portion of stipe not reddish punctate when dried and not scabrous-punctate fresh. . . . . 14
14. Fruiting body changing to "ochraceous orange" or "ochraceous buff" (rather bright brownish yellow) in drying. . . . . *H. flavodiscus* p. 12
14. Fruiting body not changing color noticeably in age or in drying, more or less yellow at maturity and drying pale yellowish. . . . . *H. gliocyclus* p. 11
15. Pileus bright lemon yellow over all, not reddish. . . . . *H. lucorum* p. 13
15. Pileus differently colored. . . . . 16
16. Pileus scarlet to bright orange red, fading to yellowish at least on the margin. *H. speciosus* p. 15
16. Pileus dark olive brown on disc (at least when young) colors becoming brighter yellow in age. . . . . *H. hypothejus* p. 15
17. Spores 6–8 (9)  $\mu$  long. . . . . 18
17. Spores (8) 9–12  $\mu$  long (8–10  $\mu$  in *H. tephroleucus*). . . . . 19
17. Spores (12) 14–18 (20)  $\mu$  long. . . . . *H. megasporus* p. 25
18. Pileus more or less ashy gray, stature of *H. eburneus*. . . . . *H. occidentalis* p. 18
18. Pileus olive brown to nearly black on the disc, robust. . . . . *H. fuliginus* p. 22

\* The page numbers given after a name refer to the page on which is found the description of the species in Smith and Hesler (20). When only a number is given, the description is given in the text following this key.

19. Stipe with a fuscous, fibrillose sheath beneath the gluten often forming a submembranous to fibrillose-floccose superior annular zone..... 20
19. Stipe not as above..... 21
20. Pileus 3-8 (10) cm. broad..... *H. olivaceoalbus* p. 23
20. Pileus 1.5-3.5 cm. broad..... *H. olivaceoalbus* var. *gracilis* p. 23
21. Odor strongly farinaceous when flesh is crushed..... *H. multifolius* p. 28
21. Odor not farinaceous..... 22
22. Pileus 5-10 cm. broad, spores (8) 9-11×5-7μ..... *H. paludosus* p. 20
22. Pileus 1-4 (5) cm. broad..... 23
23. Stipe with conspicuous punctate points over the upper portion..... *H. pustulatus* p. 27
23. Stipe with bright yellow fibrillose squamules which become grayish in age..... *H. tephroleucus* var. *aureofloccosus* p. 26
23. Stipe with fine fibrillose cinerascens pointed squamules over the upper portion..... *H. tephroleucus* p. 25
24. Spores large, 11-14×6-7.5μ..... *H. vernalis* (No. 8) 25
24. Spores smaller (6-9μ long)..... 25
25. Pileus ferruginous to rufous, fading to sordid salmon color..... *H. subsalmonius* p. 30
25. Pileus tawny to russet or pale pinkish brown..... 26
26. Stipe (5) 10-20 mm. thick..... 27
26. Stipe 3-5 (8) mm. thick..... *H. discoideus* p. 29
27. Spores 5-6μ broad..... *H. variicolor* p. 29
27. Spores 3.5-4.5μ broad..... *H. lauræ* p. 12
28. Odor faintly aromatic..... *H. pusillus* p. 34
28. Odor not distinctive..... 29
29. A dry membranous to coarsely fibrillose veil present, typically forming a subbasal annulus or annular zone..... *H. subalpinus* (No. 5) 30
29. No veil present..... 30
30. Spores 6-7×2-3μ..... *H. subsordidus* (No. 7) 31
30. Spores 4-5μ broad..... 31
31. Pileus 1-4 cm. broad, (stature of *H. eburneus* or *H. niveus*)..... *H. albidus* p. 34
31. Pileus 8-20 cm. broad..... *H. sordidus* p. 32
32. Flesh unchanging when cut or bruised..... 34
32. Flesh changing to yellow when cut or bruised..... 33
33. Pileus more or less salmon-colored..... *H. fragrans* p. 36
33. Pileus pale yellowish buff..... *H. fragrans* f. *pallidus* p. 38
34. Taste or odor distinctive..... 35
34. Taste or odor not distinctive..... 36
35. Odor aromatic, spores 11-14μ long..... *H. pacificus* p. 42
35. Odor aromatic spores 8-10×4-5μ..... *H. Bakerensis* (No. 9) 35
35. Order resembling that of raw potatoes, taste bitter, pileus tawny to fawn color..... *H. tennesseensis* p. 40
35. Odor none, taste bitter, pileus reddish to tawny-red (*H. amarus* may ket out here also)..... *H. laricinus* (No. 2) 36
36. Pileus 5-12 cm. broad, stipe reddish punctate when dried..... *H. pudorinus* p. 36
36. Pileus 4.5-7 cm. broad, stipe not reddish-punctate in dried condition..... *H. subisabelinus* p. 40 (see *H. saxatilis* No. 10 also) 37
36. Pileus 2-5 cm. broad..... 37
37. Stipe glabrous, pileus dry..... *H. subrufescens* (No. 6) 37
37. Stipe densely pruinose, pileus viscid..... *H. roseibrunneus* p. 42
38. Lamellae crowded and long decurrent as in species of *Clitocybe*..... *H. proximus* p. 50
38. Lamellae not long-decurrent..... 39
39. Taste persistently bitter..... *H. amarus* p. 50
39. Taste not bitter..... 40
40. Fibrillose veil present forming an evanescent zone near the apex of the stipe..... *H. purpurascens* p. 53
40. Fibrillose veil not present..... 41
41. Spores long and narrow, 8-12×2.5-3.5μ..... *H. russuliformis* (No. 4) 41



41. Spores broader than in the above. . . . . 42  
 42. Pileus evenly dark wine red, lamellae often concolorous with the pileus. . . . . *H. capreolarius* p. 51  
 42. Pileus dull rose to purplish on the disc, margin paler, gills soon spotted. . . . . 43  
 43. Pileus 2-3 cm. broad. . . . . *H. erubescens* var. *gracilis* p. 48  
 43. Pileus larger. . . . . 44  
 44. Lamellae close to crowded, 120-130 reach the stipe. . . . . *H. Russula* p. 46  
 44. Lamellae subdistant to close, 75-95 reach the stipe, stipe rather slender. . . . . *H. erubescens* p. 48  
 45. Odor aromatic. . . . . *H. agathosmus* p. 53  
 45. Odor none or very slight. . . . . 46  
 46. Upper portion of stipe white floccose-scabrous. . . . . *H. fusco-albus* var. *occidentalis* p. 58  
 46. Upper portion of stipe not floccose-scabrous. . . . . 47  
 47. Spores 10-12 $\mu$  long. . . . . *H. nigridius* (No. 3)  
 47. Spores smaller. . . . . 48  
 48. Pileus soon dry, gills cinerascens. . . . . *H. caprinus* p. 55  
 48. Pileus remaining viscid, gills remaining white or becoming evenly flushed with very pale pink. . . . . *H. calophyllus* p. 55

### ADDITIONS TO THE SUBGENUS LIMACIUM

#### 1. HYGROPHORUS BURNHAMI Peck.

"Pileus fleshy, broadly conic becoming convex or nearly plane, moist in wet weather, glabrous or slightly and obscurely innately fibrillose on the margin, blackish brown, flesh white; lamellae narrow, sometimes forked, subdistant, adnate or slightly decurrent, white; stem equal, sometimes pointed or abruptly narrowed at the base, fibrillose striate, solid, whitish becoming tinged with the color of the pileus, white within and white tomentose at the base; spores elliptic, .0003-.0004 of an inch long. .0002-.00024 broad.

"Pileus 1-2 inches broad; stem 1.5-3 inches long, 4-6 lines thick.

"Gregarious. Growing in mixed woods. West Fort Ann, Washington county. October. S. H. Burnham.

"This species is a near ally of *H. caprinus* (Scop.) Fr. from which it may be separated by its more glabrous pileus, more narrow and closer lamellae which also are less decurrent. The stem is paler than the pileus and generally slightly radicated at the base and there covered with a white mycelioid tomentum. The lamellae are about 1 line broad."

The above is quoted from the original account. The type has been examined. The spores were 7-10 $\times$ 4-5 $\mu$ , ellipsoid and not amyloid. The basidia were four-spored and measured 38-46 $\times$ 5-7 $\mu$ . Cheilocystidia and pleurocystidia were not differentiated. The gill-trama is of divergent hyphae, but in order to demonstrate this from dried specimens, the sections must be very carefully made. No gelatinous pellicle was seen on the sections of the pileus. Dearnass has noted on the packet that he believes the species is the same as *H. caprinus* of Atkinson and Kauffman. Our study of the type has convinced us that it is properly referred to *H. caprinus* as a synonym. During October, 1941, at Olympic Hot Springs in the Olympic Mts. of Washington, *H. caprinus* fruited in great abundance. It was found scattered in wide areas under conifers or growing either in arcs or in large

clusters. In most of the material from this locality the stipes were whitish or pale gray. Because of the deep carpet of moss over the forest floor, most of the specimens, even those in large clusters remained nearly buried in the moss or had only the pilei protruding above it. In more open areas such as old trails or along roads, the stipes were more or less concolorous with the pileus. We attribute the difference in the observed color of the stems to be merely a variation caused by the habitat. European authors often describe the species as being quite robust. In Smith's No. 17980 the pilei measured up to 10 cm. broad, the stipes 13 cm. long and 2 cm. thick at the apex. European authors quite frequently mention a bluish-fuscon form and Bresadola (1) has illustrated such a form for the species. One fruiting body belonging here was found at Olympic Hot Springs by Smith in 1941 (No. 17919). Its colors are strikingly different from those of the common form. It may be desirable to give it taxonomic recognition if it is found to differ consistently from the typical form in the character mentioned. No distinctive odor was present in material of either. The species as it occurs in Europe is also said to be odorless, hence the specimens from Lake Timagami previously cited by Smith & Hesler (20) appear to be atypical in this respect.

## 2. HYGROPHORUS LARICINUS Peck.

"Pileus fleshy, convex or nearly plane, viscid when moist, reddish, tawny red or grayish red, flesh white, slightly yellowish under the adnate cuticle; lamellae distant, adnate or slightly decurrent, whitish; stem equal, firm, hollow, white; spores elliptic, .00024 to .0003 of an inch long, .00016 to .0002 broad.

"The larch *Hygrophorus* grows under tamarack trees in a gregarious manner and sometimes in great abundance. The cap in the young plant is very broadly conic or convex but it expands with age till it is nearly or quite flat. It sometimes has a small central prominence or umbo. Under a lens the surface has a slightly silky appearance. The color is some shade of red and may be rusty red, tawny red or grayish red. The extreme margin is sometimes white, and in some specimens a reddish brown encircling line or narrow band is seen near the margin. Occasionally the margin is yellow. The flesh is white, slightly tinged with yellow under the inseparable cuticle. . . . The gills are white and not closely spaced side by side. They are broadly attached to the stipe or slightly decurrent on it. The stem is white, stuffed or hollow and rather short. It is 1 to 2 inches long and 2 to 3 lines thick. The cap rarely exceeds 1 inch in diameter. It has been found near Warrensburg only. It appears in October."

The above is quoted from the original account. The type is well preserved. The specimens have dried "pale pinkish buff" over all. This is a very pale color and strikingly different from the fresh colors as described and illustrated by Peck. The apex of the stipe appears finely silky under

a lens. Sections were made and the gill-trama was found to be of divergent hyphae. This of course places the species in *Limacium* where it should be arranged next to *H. Kauffmanii*. There is a thin gelatinous pellicle over the pileus and all parts, basidia, trama and flesh are yellowish in iodine. The spores measure  $6-7.5 \times 3-4\mu$  and are not amyloid. Kauffman in his unpublished key placed the species in *Hygrocybe* and Murrill included it in his *Hydrocybe*. In our (20) study of the species of *Limacium* we failed to consider it because of the disposition made of it by these investigators.

### 3. *HYGROPHORUS NIGRIDIVS* Peck.

"Pileus fleshy, convex, obtuse or subumbonate, glabrous, grayish-brown, often a little darker in the center, flesh white; lamellae distant, decurrent, white; stem rather slender solid, brownish, white at the top; spores elliptical, .0004 to .0005 in. long, .00024 to .0003 broad.

"Pileus 1 to 2 in. broad; stem 1 to 2 in. long, 2-4 lines thick.

"Gregarious or rarely two or three united at the base. Pine and fir tree woods. Prince Edward Island. October and November, J. MacSwain.

"This fungus differs from *H. caprinus* Fr. in its smaller size, glabrous pileus and larger spores."

We have not located the type and have been unable to determine whether it is a *Limacium* or not. We place it here because of its apparent relationship to *H. caprinus*. It could possibly be a two-spored form of the latter.

### 4. *HYGROPHORUS RUSSULIFORMIS* Murrill.

"Pileus convex to depressed, gregarious, 5-7 cm. broad, surface viscid, fibrillose-squamulose, vinosus at the center, lilac with vinose streaks on the margin, which is even, entire to undulate, incurved when young; context thick, firm, white, unchanging, odorless, mild; lamellae adnexed, rounded behind, narrow, inserted, crowded, entire, white, slightly purplish when bruised; spores oblong, obliquely apiculate, smooth, hyaline, granular,  $8-12 \times 2.5-3.5\mu$ ; cystidia none; stipe enlarged below, striate, solid, white at the apex and within, white streaked with vinosus below, about  $3-4 \times 1.5-2$  cm."

The type was collected in Florida. The above is quoted from the original account. We have examined authentic material very kindly sent us by Dr. Murrill, and have been able to verify his observations on the microscopic characters. The spores are  $8-12 \times 2.5-3\mu$ , not amyloid, and most peculiar for an *Hygrophorus*. The pileus is covered by a distinct gelatinous pellicle and both the flesh of the cap and the gill-trama are yellowish in iodine. The gill-trama is very likely of divergent hyphae although in most sections of revived material it appears interwoven. Sections were allowed to stand several hours in chloralhydrate-iodine solution and in these the trama revived almost completely and appeared somewhat divergent. The species

is obviously closely related to *H. Russula* (*Melanolenca Russula* of Murrill).

#### 5. HYGROPHORUS SUBALPINUS Smith.

Pileus 4-6 cm. broad, broadly convex when young, becoming obtuse or plane, sometimes with a slight umbo and the margin spreading or decurved, opaque, snow-white over all and with a distinct luster, viscid, pellicle thin and scarcely separable from the flesh, merely subviscid in age, not discoloring appreciably, often having patches of the broken veil adhering along the margin; flesh thick (1 cm.  $\pm$  near the stipe), white, soft, odor and taste perfectly mild; lamellae decurrent from the first, close (68-113 reach the stipe, many very narrow individuals extend to the stipe making the count difficult), narrow (3-4 mm.), 1 row of short individuals, concolorous with the pileus or a duller white, edges even; stipe short, 3-4 cm. long, 1-2 cm. thick at the apex, base bulbous when young, nearly equal in age, somewhat rounded beneath the bulb, solid, white within, peronate to the apex of the bulb by a white membranous sheath which terminates in a flaring submembranous to fibrillose inferior annulus, white and silky above, annulus sometimes evanescent, no gelatinous universal veil evident; spores 8-10  $\times$  4.5-5  $\mu$ , ellipsoid, smooth, hyaline; basidia four-spored; cheilocystidia and pleurocystidia not differentiated; gill-trama of divergent hyphae; pileus-trama homogeneous beneath a thin gelatinous pellicle.

Gregarious under fir at about 6000 ft. elevation, Deer Park, Olympic Mts., Washington, June 16, 1939 (14397-S). Also found on Crystal Ridge, 5000 ft. elev. June 17, 1939 (14418).

#### 6. HYGROPHORUS SUBRUFESCENS Peck.

"Pileus fleshy, but thin on the margin, convex or nearly plane, dry, minutely floccose squamulose, pale pink or grayish red, flesh whitish, faintly tinged pink, taste mild; lamellae subdistant, decurrent, whitish; stem rather long, equal or nearly so, flexuous, glabrous, solid, white; spores elliptic, .0003 of an inch long, .0002 broad.

"Pileus about 1 inch broad; stem 1.5-3 inches long, 2-4 lines thick. Among fallen leaves in woods. Port Jefferson, Suffolk county. August.

"This species belongs to the section *Camarophyllus* and is related to *H. leporinus*, from which it may be separated by its different color, thinner margin of the pileus and glabrous stem."

The above is quoted from Peck (13). We have examined the Port Jefferson specimens (the type) and found the gill-trama to be divergent. Consequently the species is a *Limacium*. There is merely a loose layer of non-gelatinous hyphae over the surface of the pileus, and no cystidia are differentiated on the gills. The spores are not amyloid and measure 5-6  $\times$  3.5-4  $\mu$ . The basidia are four-spored and measure 48-60  $\times$  5-6  $\mu$ .



Superficially dried specimens of *H. subisabellinus* are very close to *H. subrufescens*, but differ in having a gelatinous pellicle. When fresh the colors should readily separate them. *H. subrufescens* dries a pale buff color over all and hence herbarium specimens are easily distinguished from those of *H. roseibrunneus* Murr. The densely pruinose stipe of the latter should distinguish it when fresh.

7. *HYGROPHORUS SUBSORDIDUS* Murrill.

"Pileus convex to slightly depressed, gregarious or scattered, 6-9 cm. broad; surface viscid but not slimy, smooth, glabrous, white, margin even, undulate or lobed; context thick, watery, white, odorless, mild; lamellae adnexed, narrow, inserted, distant a few forked midway, entire, white, unchanging; spores cylindric, smooth, hyaline, granular, about  $6 \times 2\mu$ , some  $7 \times 3\mu$ ; cystidia none; stipe tapering downward, smooth, slightly pruinose at the apex, glabrous below, white, unchanging,  $3-4 \times 1-2$  cm."

The type was collected in Florida. Authentic material, distributed by Murrill, has been examined. The spores are as he described them. The spores and flesh of the pileus are not amyloid. The pileus is characterized by a rather thick pellicle of gelatinous hyphae, and the gill-trama is divergent. The basidia are four-spored and measure  $36-42 \times 5-6\mu$ . The pileus of the specimen examined was almost snow-white. As Murrill has pointed out, the species has a decided resemblance to *H. sordidus* but is easily distinguished by the narrower spores.

8. *HYGROPHORUS VERNALIS* Smith.

Pileus 3-5 cm. broad, obtuse when young and with an incurved white downy-pubescent margin, obtusely umbonate in age, surface glabrous and viscid, margin "pale vinaceous-fawn," the disc "vinaceous-buff" and with spots when young, in age flushed over all with brighter pale vinaceous colors; flesh thick, concolorous with the surface or whitish-vinaceous, odor and taste not distinctive lamellae arcuate when young, long decurrent in age, close, 50-55 reach the stipe, narrow (3.5 mm.  $\pm$ ), whitish (paler than the margin of the pileus), edges even; stipe 4-6 cm. long, 7-9 mm. thick, equal or slightly enlarged at the base, stuffed or becoming hollow, lower portion covered by a thin layer of gluten which forms sordid yellowish patches of varnish over the basal area, appressed cottony fibrillose to the apex (not punctate above), sordid whitish or concolorous with the gills, darker in age; spores  $11-14 \times 6-7.5\mu$ , ellipsoid, hyaline, smooth; basidia four-spored,  $62-65 \times 10-11\mu$ ; gill-trama of divergent hyphae; pileus-trama homogeneous beneath a gelatinous pellicle.

Scattered under conifers in the lower Hudsonian zone below Deer Lake, Olympic National Park, Washington, May and June, 1940.

9. *Hygrophorus Bakerensis* sp. nov.

Pileus 4-15 cm. latus, obtuse conicus vel obtusus, glutinosus, pallide

fulvus; caro albida, odore aromatica, sapore miti; lamellae confertae vel subdistantes, pallidae, late adnatae vel decurrentes; stipes (4) 7-14 cm. longus, 8-25 mm. crassus, aequalis vel deorsum attenuatus, solidus, albidus, sursum pruinosis, deorsum impositus, siccus; sporae 8-10 $\times$ 4-5 $\mu$ .

Pileus 4-15 cm. broad, obtuse when young, the margin incurved and cottony, in age becoming plane or nearly so, the margin sometimes elevated, surface glutinous when wet, merely viscid in age, appressed fibrillose beneath the gluten, margin whitish, disk "Sudan brown" shading to "tawny olive" or "amber brown" shading to "cinnamon buff" toward the whitish margin (disk some shade of yellow-brown, paler toward the margin); flesh thick (1 cm. near the stipe), tapering evenly to the margin, white, firm, unchanging when cut or bruised, taste perfectly mild, odor heavy but fragrant and very characteristic even though faint, reminding one somewhat of almonds; lamellae close to subdistant (56-88 reach the stipe, 2-3 tiers of short individuals), decurrent or soon becoming so, narrow but becoming broad in large caps (8-12 mm.), creamy white, unchanging, edges even; stipe (4) 7-14 cm. long, 8-25 mm. thick at the apex, equal or narrowed downward, solid, firm, white throughout, surface dry, cottony pruinose at apex when young, merely unpolished over all in age, not staining when bruised, in moist weather often beaded with hyaline drops of liquid; pileus trama homogeneous beneath a gelatinous pellicle; gill trama of divergent hyphae; basidia four-spored; spores 8-10 $\times$ 4-5 $\mu$ , not amyloid.

Scattered to gregarious, very common under conifers at elevations of 1000 to 4000 ft. in the Cascade Mountains of Washington and Oregon and in the Olympics. It was found at Mt. Baker, Wash. Sept. 3, (16576-S), Olympic Hot Springs, Olympics, Wash. Sept. 20, (17441-S), Oct. 2, (17490—type), Oct. 4, (17528-S), Oct. 8, (17695-S) and at Lost Creek, near McKenzie Pass, Ore. Oct. 30, 1941 (18171-S).

*H. Bakerensis* bears the same relationship to *H. variicolor* that *H. albidus* bears to *H. eburneus*; it differs in having a dry stipe. Abundant material was collected under nearly all weather conditions and the stipe was never found to be furnished with even a slight gelatinous veil. Dried specimens of both species appear identical. The caps have a dull red-brown color and the gills darken appreciably. The odor is easily missed if one has just a few fruiting bodies, but in large collections it is very distinct.

#### 10. *Hygrophorus saxatilis* sp. nov. Plate 18.

Pileus 3-8 (10) cm. latus, obtusus demum subplanus, viscidus, glaber vel subfibrillosus, pallidus demum pallide alutaceus; lamellae incarnato-ochraceae, subdistantes, late adnatae vel decurrentes; stipes 6-8 (12) cm. longus, 10-15 (20) mm. crassus, subaequalis, pallidus, siccus, fibrillosus, apice pruinosis; sporae 7-9.5 $\times$ 4-5 $\mu$ .

Pileus 3-8 (10) cm. broad, obtuse with an inrolled margin when young, becoming plane or with a low obtuse umbo and decurved finely pubescent

margin, slightly viscid when young and moist but soon merely moist or dry, glabrous or when dry appearing appressed fibrillose under a lens, color whitish to very pale buff with a developing cinnamon tinge ("pale pinkish buff" to "light pinkish cinnamon") and occasionally spotted or zoned with "pinkish cinnamon" spots or zones; flesh thick, soft, watery-punctate and



Plate 18. *H. saxatilis* Smith & Hesler,  $\times 1$ .

"pinkish buff" to "light pinkish cinnamon," taste mild, odor lacking or faintly fragrant and reminding one of dried peaches; lamellae "light ochraceous salmon" to "light pinkish cinnamon" (more or less pinkish cinnamon-tan) and very beautiful, evenly colored, bright when young and becoming duller in age, subdistant (30-36 reach the stipe), 1-2 tiers of short indi-

viduals, frequently more or less wrinkled or crisped, short decurrent, very soft and fragile, narrow to moderately broad (3-6 mm. and tapered both ways), rather thick, edges even; stipe 6-8 (12) cm. long, 10-15 (20) mm. thick at apex, equal or narrowed slightly toward the base, solid, flesh concolorous with that of pileus, unchanging, surface whitish or concolorous with the pileus, dry, thinly appressed-fibrillose to the fibrillose-pruinose apex, often appearing more or less longitudinally striate, glabrescent in age and then concolorous with the gills; pileus trama homogeneous beneath a very thin gelatinous pellicle; gill-trama of divergent hyphae; spores  $7-9.5 \times 4-5\mu$ , subellipsoid, not amyloid, smooth; clamp connections present on the hyphae forming the pellicle of the pileus.

Scattered under conifers on steep hillsides or very rocky dry soil, Olympic Hot Springs, Olympic Mts. Wash. Oct. 8 (17665-S); Oct. 11 (17769-S); Oct. 15 (17896-S); Oct. 17 (17979-S); and Lost Creek, Ore. near McKenzie Pass, Oct. 30, 1941 (18156-S—type).

This is a very striking and easily recognized species because of the beautiful gills. The odor is very easily missed in collections of only a few fruiting bodies, but when several baskets full are brought into a room the odor soon becomes very noticeable. At Lost Creek, Ore., where the fungus was found most abundantly it was noticed that spore prints made on the top of one cap by an overhanging pileus were more or less dark ochraceous salmon in color, quite a bit darker than the color of the pileus on which the deposit was made. All spore prints made in the laboratory from these and other pilei were white. As yet we have no explanation for these observations. At least a dozen colored spore-prints were observed in the field at Lost Creek, and it was apparent that the age of either cap had no bearing on the situation. The habitat of this fungus is peculiar insofar as our data go, but data based on a single season's collections must not be given too much emphasis. The character of the stipe is also peculiar for a *Limacium* in that it is evenly fibrillose at first and pruinose at the apex instead of scabrous. No signs of a veil were visible in the smallest buttons. It appears to be related to *H. Karstenii* Sacc. & Cub. but differs in its more or less salmon colored rather than yellow gills.

#### EXCLUDED AND DOUBTFUL SPECIES

The descriptive material given for the following species is quoted from the original accounts. We have not been able to obtain data on the type specimens of any except *H. Graciae*.

#### HYGROPHORUS AURANTIACO-LUTEUS Berk. & Curt.

"Gregarious, deep orange. Pileus  $\frac{1}{4}$  inch across, at first convex, then flat or somewhat depressed, smooth, striate; stem  $1\frac{1}{2}$  inch high, not 1 line thick, attenuated downwards, smooth; gills arched, strongly decurrent. This species has precisely the habit of *Agaricus fibula*."



## HYGROPHORUS GRACIAE Sumstine.

"Pileus conic, campanulate with a cuspidate umbo, crenate, striate, lemon yellow, brown-yellow when dry, 1-2 cm. broad, scarcely viscid, not turning black in drying; flesh thin; lamellae broad, waxy, adnato-decurrent; stipe concolorous or lighter than the pileus, subequal, hollow, 5-9 cm. long, tomentose at the base; spores irregular, angular, 8-10 $\mu$ .

"Growing in mossy places in mixed woods, near Kane, Pennsylvania, September 5, 1937, Grace H. Sumstine. Type has been deposited in the Carnegie Museum."

We have examined a fruiting body from the type collection and found it to be identical with specimens of *Entoloma cuspidatum* Pk. *Entoloma salmoneum* Pk. is another pink-spored agaric which has the appearance of an *Hygrophorus*.

## HYGROPHORUS HAEMATOCEPHALUS Berk. &amp; Curt.

"Pileus 1-2 inches across, fleshy, brittle, convex, umbilicate, blood red. Stem 1-2 inches high,  $\frac{1}{2}$ -2 lines thick, attenuated downwards, brittle, hollow, compressed, reddish above, becoming pale or yellow below. Gills ventricose, adnate, broad, thick, irregular, yellow, interstices even. Spores white, elliptic."

## HYGROPHORUS LURIDUS, Berk. &amp; Curt.

"Pileus  $\frac{3}{4}$  of an inch broad, campanulate, umbonate, very viscid, pale brown, darker in the centre; margin striate, crenate. Stem  $1\frac{1}{2}$  inch high, one line or more thick, pale brown like the pileus, fistulose, composed of longitudinal fibres. Gills white, ventricose, shortly adnate, thick, connected by veins.

"Not very closely allied to any described, except perhaps to *H. unguinosus* with which it agrees closely in technical characters, but is very different in habit. *H. unguinosus* is a much larger and more robust species."

## HYGROPHORUS MUCILAGINOSUS Berk. &amp; Curt.

"Pileus  $\frac{1}{2}$ - $\frac{3}{4}$  inch broad, convex, at length plane, striate, very mucilaginous, of a bright pale reddish yellow, darker in the centre. Stem 1-2 inches high, a line or more thick, composed of longitudinal fibres, brittle, fistulose, subpellucid, pale yellow or carneous. Gills subdecurrent, unequal distant, fleshy, flesh-colored.

"Allied to *H. cantharellus*, Fr. The habit is that of some varieties of *Ag. umbelliferous*. It is at once distinguished by its very mucilaginous pileus and thick gills from *H. cantharellus*, and by its brittle stem from *H. laetus*."

## HYGROPHORUS OHIENSIS Mont.

"Pileo carnosio, e convexo expanso viscido, e luteolo purpurascente,

carne flava; stipite solido concolori aequali; lamellis postice latissimis rotundato-adnexus e roseo fulvellis; sporis ovoideis albis.

Hab. In ligno in teram dejecto. Columbus: Sullivant: Icon. 163.

Desc. Pileus convexus, demum expansus,  $2\frac{1}{2}$  centim. latus, luteolus, disco purpurascens, satis carnosus, udus viscidus, laevis, margine in sicco incurvo, madido patente, haud striatus. Caro flava. Stipes solidus,  $2\frac{1}{2}$  centim. longus, 2 millim. crassus, basi orbiculatim ligno affixus. Lamellae tridymae, omnes postice latissimae rotundatae, antice attenuatae, siccae fulvellae, olivascentes, subpulveraceae. Sporae albae, ovoideae, minutissimae.—Cum nullo conferendus.”

#### HYGROPHORUS STENOPHYLLUS Mont.

“Caespitosus, totus albus; pileo carnosio inaequali margine undulato-repando revoluto infundibuliformi, udo viscido; stipite solido brevi subflexuoso; lamellis confertissimis angustissimis siccis crispis utrinque acutis decurrentibus.

“Hab. In pratis, julio. Columbus: Sullivant. Icon. n. 117.

“Desc. Individua quatuor vel quinque basi juncta. Fungus totus albus, ex icone ad vivum facta pallide ochraceus. Pileus carnosus, carne fere centim. crassa, fibrosa, inaequalis, sed nunquam dimidiatus, margine undulato-repando involutus et revera infundibuliformis disco viscido laevi. Stipes brevis, 1–2 centim. longus, 4–6 millim. crassus, ut pileus fibroso-caseosus, solidus, leniter flexuosus, e basi radices aliquot terram intrantes emittens. Lamellae confertissimae, angustissimae, cum vix millimetrum latitudine adaequant, utrinque acute desinentes et stipiti decurrentes. Sporae ovoideo-oblongae, albae, diametro majori centimillim aequantes.

“Obs. Etsi *Hygrophoro virgineo* proxima species, ab eo tamen forma pilei, stipite solido necnon lamellis angustissimis, confertis crispatis-que manifeste differt.”

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## The Publication Dates of "La Naturaleza"

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Because of the recent re-awakening of interest in the natural history of Mexico—an interest that waned soon after a brilliant start in the late 19th century—it should be of considerable importance to establish as well as possible the dates of publication for perhaps the most important journal in the whole field. This is *La Naturaleza*, published between 1869 and 1912 by the Sociedad Mexicana de Historia Natural (jointly with the Museo Nacional de Historia Natural between 1910 and 1912). In it numerous important contributions to the knowledge of the fauna and flora of the country have appeared, among them many original species descriptions.

Sections of the journal appeared very erratically. At first they were issued in small entregas or signatures of 16 or 24 pages. Beginning with volume four, not only was the general text carried in consecutive pagination in each volume, but in addition several entregas carried other sections such as appendices, "Revista Científica" and monographic works (generally reprints) such as "Orchidianum Opusculum," etc. All these were given a pagination separate from the general text, and were carried erratically through the various volumes in succeeding entregas. As a rule, of course, the end of the entrega did not correspond with the end of the article, and as a result some articles, begun in one year, were not completed until the following year.

Later, beginning with the second series, the journal was issued in larger sections, called cuadernos, and in this form was continued until publication of the journal ceased. In both the second and third series, however, as in the later volumes of the first series, several separately paged portions were carried at the same time.

Practically all copies of the journal were bound by placing together the different issues of the various serial sections, so that all the text as well as the appendices are consecutively paged. As a result of this highly complicated method of publication, and the unfortunate complication in binding, it has been almost impossible for recent students to determine the actual dates of publication of various articles, except in rare cases in which certain entregas or cuadernos are bound in their original covers. So seldom are these available, especially for the first series, that apparently no library in the United States or Mexico has a complete series of them.

Certain cuadernos and entregas I have been fortunate enough to find in Mexico; others have been borrowed from several libraries; and Dr. E. H. Taylor has very kindly supplied information on certain others in his personal Mexicana. Finally, through the kindly cooperation of the Bibliofilm Service of the Science Service in Washington, D. C., I have been able



to secure photographic copies of all covers, with pagination, of sections not otherwise available. It has thus been possible to secure the *printed* year of publication for every issue of the entire journal. Of course, the printed date may not correspond with the actual date of printing and mailing, although issues appeared at such frequent intervals (for the first series) that in general they may be relied upon. There has been, of course, no reliable method of checking publication dates more accurately and in more detail. Dates of receipt of certain issues at the Library of Congress in Washington, D. C., are stamped on the covers, but they are so erratic that no attempt has been made to record them; furthermore, the United States libraries are at such a distance from Mexico City, and the means of communication so slow and unreliable in the early days of the journal, that dates of receipt in the United States may be more misleading than helpful. Accordingly the following chronological arrangement is based solely upon printed cover dates.

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